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CHRONIC

JOINT DISEASE:

(Some Preliminary Papers.)

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BY

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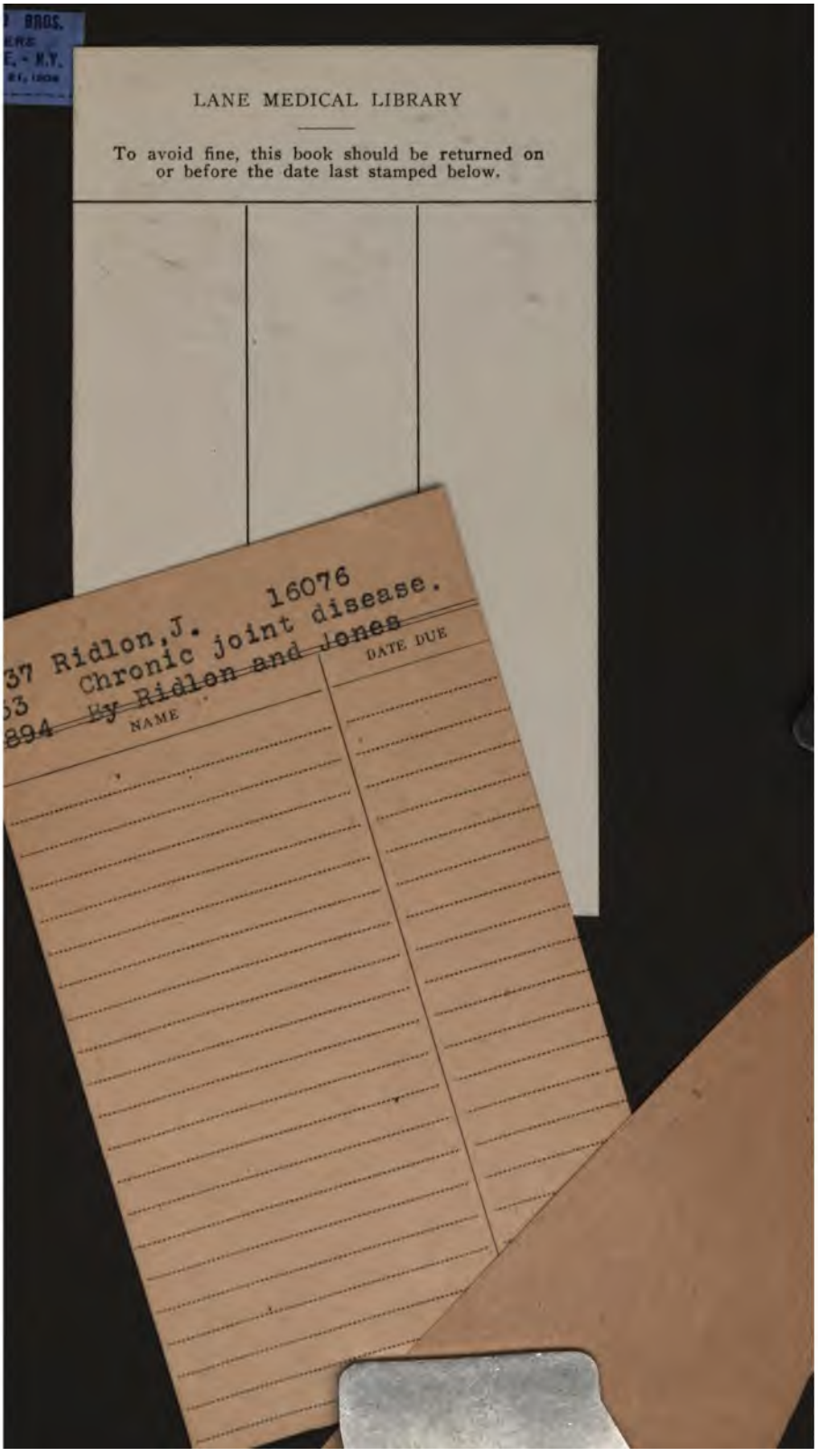
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This work is dedicated with infinite love and respect to the memory of

HUGH OWEN THOMAS,

By the Authors.

PREFACE.

This volume is a reprint of the papers on chronic joint disease which the authors have published in the *Provincial Medical Journal* and elsewhere, during the past eighteen months. They are now gathered together and reprinted for the use of the students of the Northwestern University Medical School, who with some evident impatience have been awaiting a long promised volume on orthopœdic surgery by the authors, and which is still far from completion.

The authors have considered only that form of chronic joint disease which is either in the beginning tubercular, or very soon becomes so; the pathology has been discussed in but a very brief way, while the symptoms and the general principles of treatment have received reasonably careful attention. In considering the details of the treatment the authors have advised only that which they personally employ, beleiving it of more advantage to the student to learn the details of one than of many forms of treatment. It has been the aim of the authors to supplement the existing text books on Orthopœdic Surgery. It has appeared to them that many of these books contain more statistical information than the student should be asked to learn and more than the general practioner finds of interest in reading; that they have named long lists of braces for the treatment of disease at the various joints without describing any of these sufficiently minutely to enable the reader to construct them or have them constructed by the average instrumentmaker. It has been the aim of the authors to so fully describe the apparatus which they use

that the surgeon himself, or aided by an ordinary mechanic, will be able to construct a satisfactory apparatus on the spot without loss of time and at a small expense.

The subjects taken up are: Spondylitis, Hip Disease, Knee Joint Disease, Ankle Joint Disease, and Shoulder, Elbow and Wrist Joint Disease, and it has been the aim of the authors to place each subject so breifly before the reader that he will be able in all except the exceptional cases to readily make a diagnosis; to prognosticate the course of the disease without treatment; to prognosticate its course with treatment; to make or have made under his immediate supervision the necessary apparatus for the treatment; to apply such apparatus satisfactorily and to diagnosticate a cure and to know when to remove the apparatus and discontinue treatment.

CHRONIC JOINT DISEASE.

PRINCIPLES OF TREATMENT, WITH SOME REMARKS ON THE PATHOLOGY.

We use the indefinite term, chronic joint disease, after some deliberation, believing that our meaning will thus be more generally understood than by the use of a term more clearly indicating the pathology of the condition under consideration. It appears to us that all of the pathological problems of joints with chronic disease have not been solved; that, although the tubercle bacillus has been found in all, or nearly all, of the joints obtained either by excision or after death, pathological investigation has not made clear the relationship which seems to exist between joint disease unquestionably due to hereditary syphilis, tubercular joint disease in the children of syphilitic parents, and joint disease in the children of tubercular parents, all of which, clinically, often appear to be the same; nor has it marked the time when a joint, unsound from a sprain or lesser injury, ceases to be simply a traumatic joint and becomes truly a tubercular one. Until these and kindred problems have been solved and the terms of modern pathology have become familiar words, terminology, based upon the pathological condition, leads to more or less confusion of thought, and may even be open to the charge of inconsistency, or worse. The term, chronic joint disease, calls to mind a familiar picture; a joint diseased by a slow lingering process, arising from any one of several causes, but presenting the same definite symptoms, running a definite course when left untreated, and, whatever may have been its origin, requiring the same mechanical or operative treatment for its relief.

To the advanced student in orthopœdics it is interesting to speculate upon, and perchance locate, the primary focus of disease, and the date of the advent of the tubercle bacillus;

but, to the tyro in orthopœdics, whether he be the family doctor, the general surgeon, or the recent graduate, it is of chief importance after the making of the diagnosis to know the precise details, and the actual steps in the treatment of the affection. It is to these details that we shall chiefly devote our attention, believing that in an article written for the general practitioner, rather than for the orthopœdist, a discussion of the problems of pathology and etiology had better be omitted. These can be more advantageously studied in special monographs, and in volumes that may be called treatises on orthopœdic surgery, which works we endeavor to supplement rather than supplant.

Tubercular Joint Disease.—However, as nearly all of the morbid specimens of chronic joint disease that have fallen into the hands of the painstaking pathologist have been found to contain tubercle bacilli, and inasmuch as the tubercle bacillus is pretty generally believed to be the cause of all tubercular lesions, it may be proper for us to consider briefly the pathology and etiology of tubercular joint disease. For the facts bearing on these points we would acknowledge our indebtedness to Professor Fedor Krause, of the University of Halle, to whose writings we would refer our readers for a more complete consideration of the subject. In a few particulars, where our clinical observations have seemed sufficiently positive to warrant it, we have ventured to differ from Professor Krause and other writers. We shall not consider the pathology of chronic joint disease from any other than the tubercular aspect, for, despite some missing links in the chain of evidence, clinicians universally accept the teachings of pathologists, and hold that chronic joint disease and tubercular joint disease may be regarded as synonymous terms; that, however the trouble may arise, it is either tubercular at the start, or in most cases very soon becomes so; that the differential diagnosis of tubercular disease from that arising from neglected injury or from inherited syphilis can not as a rule be made; and that in either case the surgical treatment, both mechanical and operative, is the same.

Tubercular disease of the joints is found to commence with greatest frequency in the rapidly growing parts of bone, in

the neighborhood of which other tissues are often quickly involved by extension. In infants, however, one finds the diaphyses of the small bones attacked, but even after a lengthy course the neighboring joints rarely become affected. The interior of such bones is largely composed of cancellous tissue, so that it may be inferred that tubercular affection has a special affinity for this tissue.

FIG. 1.– Upper part of femur of a boy æt six, suffering from acute coxitis who died of general tuberculosis. (*a*) Cheesy spot in head of bone; it has infected the surrounding medulla (*b.b.*) for a distance. Cheesy infiltration extends to shaft. (After Prof. Fedor Krause, "Die Tuberculose der Knochen und Gelenke").

The focus may develop in one or two ways; a few bacilli are carried by the blood current to the spot in question, leaving the vessels to colonize in the vicinity; a grey tubercle develops there which enlarges by the formation of new tubercles, and according as the focus grows uniformly on all sides, or in one direction, it will have a rounded or an elongated shape. Foci formed in this way may, and usually do, appear as primary local infections.

In the second mode of development, resulting in a cone-shaped focus, we assume pre-existence of tubercular disease in some part of the body, generally in the bronchial glands or

lungs, from which a minute cheesy particle has gained access to the circulation, and, perhaps increasing somewhat from a deposit of fibrin, finally lodges in and occludes a small vessel in the epiphyses or other part of bones. Thus is formed an infarct, found to have its base at the articular surface of the bone and in contact with the cartilage, while the apex is toward the diaphysis.

FIG. 2.—Resected upper end of femur of girl æt five. Wedge shaped focus with demarcation far advanced, with base towards articular cartilage. (Prof. Fedor Krause, "Die Tuberculose der Knochen und Gelenke.")

In either case the surface of a section of the focus is greyish-red, yellowish-white, or yellow, the boundary being somewhat reddened by collateral hyperæmia. In the very early stage the transparent grey tubercles may, with the aid of a lens, be seen throughout the spot; later on they will only be found at the periphery, the central part having already become cheesy. This caseation appears to result from the extending occlusion of the blood vessels by the pressure of the growing tubercles. Thus death first appears in the center of the mass, and, as the growth extends round the circumference, the area of necrobiosis increases, and is still found to be surrounded by a grey or greyish-violet membrane, easily separable from the surrounding tissues. In this membrane bacilli may be detected in abundance, while in the cheesy mass filling the cavity they can rarely be demonstrated by microscopic examination or by cultivation; nevertheless, inoculation with this material in a rabbit's cornea invariably gives rise to tubercle, forcing us to the conclusion that spores exist therein. As a rule, the caseating process extends by liquefaction until it reaches the surface of the bone, when the synovial membrane becomes affected. In milder cases small

spots alone appear, or it may spread only to the neighboring periosteum, or on to the interior of the articulation. Occasionally a drying or dehydration takes place, and the mass may even calcify and remain unchanged for years, the surrounding hyperæmia leading to exudation of round cells and the formation of a fibrous capsule, or to sclerosis of bone. In other cases, resolution may take place before the cheesy stage has been reached, or cicatricial healing may result after suppuration or caseation by the development and encroachment of healthy granulation tissue, and sequestra of very considerable size may disappear, and only the scar remain after the manner of an ordinary infarct in spleen or kidney. There is a third but rare form, which is believed to arise from primary tuberculosis of the synovial membrane and to proceed to the destruction of the entire articular cartilage and the rapid infiltration of the exposed spongy portion of the bone, reaching even to the spongy and exposed cortical portions of the diaphasis, and finally to the medullary cylinder itself.

Synovial disease may arise secondarily to bone affection, as already pointed out. A microscopical examination of the synovial disease then shows:

(1) When primary, grey and caseating changes in the substance of the membrane.

(2) When secondary, the surface is more diseased than the deeper parts. Caseation and ulceration on the surface; miliary tubercle in the deeper parts.

Under favorable circumstances, extensive synovial disease presenting all the clinical evidence of tuberculosis not infrequently goes on to complete resolution, without destroying cartilage; whilst we have also seen the disease commence thus at the knee, and go on to such extensive destruction of ligaments and cartilage that almost complete passive subluxation laterally was possible. In this case pronounced grating could be elicited on rubbing the head of the tibia against the condyles of the femur, and yet the disease did not go on to diffuse infiltration of the bone even after so many as five spontaneous openings had formed. It ultimately resulted under treatment in a sound joint with motion to full extension and nearly to full flexion without ligamentous laxity. It is probable, however, that even under

treatment somewhat more than half of the joints "into which cheesy foci have emptied" go on to rupture, and the formation of abscess in the surrounding tissues. The size of the abscess bears no definite relation to the extent of the disease in the bone; an immense abscess may lead down to only a minute spot, or extensive disease of bone may occur without the formation of a drop of pus. As a rule, abscesses develop slowly without inflammatory symptoms; they tend to follow the line of gravity as the skin is approached. The pus presents no micro-organisms on examination by staining and cultivation, but the inoculation of the pus always results in the development of tuberculosis. This pus lacks the greenish color and uniform viscidity of phlegmonous pus. It is whitish, or of a whitish-yellow color; it may contain cheesy particles and microscopic shreds of soft parts, and at times fine granules of bone may be distinguished by the finger and thumb. Again at times it is a clear whey-colored liquor in which float large or small white or yellowish-white curds. On other occasions, in place of curds, are found only minute flocculi, more yellow in color, floating in a more turbid fluid. The walls of these abscesses (fig. 3) are made up of a greyish yellow or violet membrane (the old "pyogenic membrane") of

FIG. 3.—Lining membrane of a tubercular abscess, after a drawing by Marchand from Volkmann.

greater or less thickness, but always easily detachable, consisting of a soft brittle tissue composed essentially of heaps of closely aggregated miliary tubercles embedded in fibrin, the cavity itself being lined by this material. The sinuses formed by the spontaneous opening of these abscesses, and those which form after incision, are lined with the same membrane, its thickness appearing to depend very much upon the amount and duration of the irritation to which it has been subjected. Abscesses opening spontaneously and left without other treatment than gentle washing of the skin about their exits, rarely give rise to septic constitutional symptoms; those treated by incision and drainage, unless most favorably situated for prolonged care, rarely escape septic infection and consequent constitutional disturbance. Septic infection of an open abscess cavity is a serious or harmless accident, according to the size of the cavity, and to the directness of its connection with the diseased joint or the carious bone-cavity.

Chronic disease of the joints may come to a standstill, and recover at any stage. The tubercular tissue is replaced by healthy granulations, and these are converted into cicatricial tissue. Peri-articular connective tissue bands contract and form an obstacle to free motion at the joint. If deformity, such as flexion, has been allowed to remain during the process of recovery, the above-mentioned bands, the tendons, the fasciæ, and muscles on the flexor aspect become shortened, and offer a considerable, if not insurmountable, obstacle to any attempt at improvement of the position. If, however, recovery has taken place without deformity, ordinary use of the joint will increase the possible range of motion, and in the course of months or years as much motion will be gained as may be required for the normal use of the joint. In cases of more serious disease, when the cartilages have been destroyed and the bone ends ulcerated, recovery usually takes place with more or less complete anchylosis, fibrous or bony. In other cases still, where every reason exists for believing that the cartilage has been destroyed and the bone ulcerated, recovery takes place after proper mechanical treatment with a useful joint possessing a fair amount of motion, which as in the former cases, will increase with use.

Etiology.—Heredity plays a very important part in the etiology of tubercular joint disease. Congenital tuberculosis is extremely rare, but it cannot be denied that a certain predisposition is transmitted from parents to children, and that in the majority of cases this is necessary to render possible the development of the disease in the joints. What this inherited predisposition depends upon we do not know. On the other hand, it must be admitted that previously perfectly healthy individuals may be attacked, and it has also been noted that in certain families children of perfectly healthy parents and grandparents often develop tubercular affections. Tubercular disease of the joints may occur after acute infectious diseases, measles, whooping cough and scarlatina; or after exhausting diseases, parturition, privations and prolonged dissipations; but the best conditions of nutrition offer no certain protection against its occurrence. Severe injuries, as fractures and dislocations, rarely act as exciting causes even in predisposed persons, while slight injuries, such as sprains and contusions, perhaps because more apt to become chronic from neglect of treatment, often do so, even in those where no history of predisposition can be obtained.

Symptoms.—It is not possible to formulate a series of spmptoms characteristic of chronic joint disease. Broadly, the majority of cases fall into one or other of three classes: (1) Primary synovial disease of non-traumatic origin; (2) Bone disease either from primary infection, or secondary to disease in other tissues, associated or not with traumatism; and (3) A purely traumatic lesion which in course of time has become chronic from lack of treatment. The first class presents, often for a time, only a distended joint capsule, the normal bony outlines being indistinct or completely lost, with true or false fluctuation on palpation. There is no local elevation of temperature to the touch, no limitation of normal motion beyond that due to the mechanical distension of the parts, no muscular atrophy, and no limping except after prolonged use. The second class presents no distension of the joint and no swelling anywhere in its early stage; there is often local heat, though this may be absent, while a tender point can often be made out in superficial joints; limping begins early and is pretty constant, though there may be intermissions in some cases; muscular atrophy comes on early

and is a constant symptom, and pain comes on after a time in most cases, though it may be absent all through the disease. In the third class there is swelling, infiltration of the tissues about the joint, though neither true nor false fluctuation are present, increased heat which can always be felt, pain of an aching nature which is almost invariably present, muscular atrophy and rigidity which are always found, and finally there is a general tenderness to pressure rather than a small sharply defined tender point. As the disease progresses in either class the three pictures above shown form a composite, presenting the sum total of all the positive symptoms, while prolonged muscular spasm results in deformity; extension of the foot when the disease is at the ankle; flexion with, later, outward rotation of the leg, where the knee joint is involved; flexion of the thigh on abdomen with occasional abduction or adduction where the hip is diseased; an arch, or an angle opening forward, in disease of the spine with or without lateral deviation and torsion; flexion at the wrist and at the elbow; and in a hugging of the arm to the side in disease of the shoulder. Long continued faulty position results in contractures of all tissues on the side of the opening of the angle (or arch) of the deformity. Abscesses form in many cases. These points will be more fully discussed under treatment. General infection or cerebral meningitis supervenes in a small percentage of cases, and this more frequently after slight scrapings and stirring up of the tubercular material than after the most formidable excisions. Death has too frequently followed the scraping of a small bone cavity after the removal of its sequestrum or the scraping of an old sinus to leave any doubt upon this point.

Prognosis.—Other things being equal, the younger the patient the shorter will be the duration of the disease, and the better will be the functional result whatever plan of treatment be adopted. Smaller joints recover more quickly and perfectly than larger ones. A certain number of cases recover, either under mechanical treatment, or under operative treatment, or without any treatment whatever, with joints in fair position and possessed of good range of motion, and suppuration whether treated or untreated is no bar to this result. On the other hand, certain cases, no matter how early treatment be commenced or

how carefully carried out, will go on to recovery with short limbs and stiff joints, or ultimately to death. The duration of the disease in individual joints or particular patients cannot accurately be foretold. Relapses rarely occur if the surgeon recognizes the signs of perfect recovery. The cases that relapse after mechanical or operative treatment are those in which treatment has been suspended before the articulation has regained its soundness.

Treatment.—That the best obtainable hygienic surroundings play an important part in the treatment, does not need to be dwelt upon, but the beneficial effects of abundant sunshine and pure air should not be attributed, as they altogether too frequently are, to any exercise which the patient may take while out of doors. Voluntary physical exertion is not essential to the perfect action of any of the vital functions or to the prolongation of life even in a healthy individual, much less is it requisite for the eradication of disease and the restoration of tissues destroyed by disease. No one has had so limited a field of observation as not to have known persons living in exceptionally perfect health and to a great age without being able to go about. Everyone knows the importance of rest to the part and to the whole man in the cure of disease, and that this application of rest is most impertively invoked in the restoration of solutions of continuity in the human frame, and in the healing of wounds, whether natural or artificial. No one questions the necessity of keeping a fractured bone at rest until healing has become perfect, or of controlling, with equal vigilance, the person of a patient afflicted with a continued fever; and there appears to us no valid reason why diametrically opposite principles should prevail in the treatment of joints where both loss of bony continuity and fever are often prominent symptoms. Such, however, has been the case. Despite these clear indications, supported as they are by the unanimous testimony of the surgical experience of all past time, one finds the principle of rest too often wholly neglected or only half-heartedly carried out; for we are constantly met by the arguments of those who look upon exercise both of joint and patient as essential to recovery. If rest be advised, it is so imperfectly adhered to as to render it of little avail. That

this is so cannot surprise us, when we recognize that no text book has supplied us with a test which will enable us to declare positively whether an articulation has recovered or not. Without this test one must be guided by the hap-hazard element of rule-of-thumb; and thus we find some laying stress upon the disappearance of abscess, some upon the absence of pain, others on movement as signs of recovery, the fallacies of which we shall later exemplify.

Let us endeavor, then, to clearly understand the indications, and, understanding them, put aside all things mysterious and follow them without faltering.

A swollen and tender joint should be immobilized as carefully as if it has been sprained. A joint partially protected from motion by involuntary spasm of the muscles should be more perfectly protected by some mechanical device. When movement causes pain in spite of the protecting muscular spasm, it should be prevented as carefully as when a like condition obtains in fracture; this demands recumbency when the lower extremities or the spine are the seat of the disease, but in the upper extremity a mechanical device may be sufficient without recumbency. When pain is severe or continuous enough to materially affect the patient's health, as indicated by either loss of sleep, appetite, or bodily weight, freedom from exercise and absolute rest in bed are clearly indicated. When the patient is feverish he should be kept in bed, and as absolutely at rest as with any other fever of equal severity. If there be a solution of continuity in any of the tissues, healing will take place most rapidly if the part be kept at rest. All wounds, whether the result of the surgeon's knife or of spontaneous evacuation, require rest for their rapid and perfect healing, and wounds resulting from tissue destruction by the encroachments of tubercular growths are no exception to this law. The materials to be used for securing local rest are of as little importance in principle as are the materials used in the construction of the bed upon which the patient lies to secure general rest. The essentials are that the framework be firm, unyielding, and free from tremor; that the padding be sufficient to protect the soft parts from harmful pressure, nor yet so soft nor so thick as to diminish the effectiveness of

the rigid frame. The covering material must be of such a nature as to be well borne by the skin, and not be readily injured or rendered baneful by secretions or excretions. It should be so applied, if possible, as not to circumferentially compress the part diseased, for such compression delays the healing process as effectually as it checks growth. Compression has been advocated in the treatment of tubercular joints, because it partially prevents their increase in size, but we fail to see how the tubercular process can be stayed or the replacement of tubercular by healthy tissue brought about by this means. We believe that such compression of a tubercular joint does no good, but does harm, and we advocate the fixation of the joint by other means in all cases where it is possible. In the same way all local applications to the skin (with the exception of mercury in the children of syphilities) are not only useless, but harmful. Any foreign body, such as dead bone, cheesy focus, or abscess contents, that the surgeon considers must be removed before a complete healing can result, should be got rid of as soon as it can be diagnosed, and with the least possible laceration of the surrounding parts; a knife and chisel always being used in place of a spoon and saw. The greatest gentleness and swiftness should be exercised, and all stretching and scraping or other mangling of the tissues should be as carefully avoided as if the patient were not under the influence of an anæsthetic. Fragments of dead bone should be removed only when they can be separated from the living bone. Dead bone still attached to living bone should not be scraped with the so-called sharp spoon; the local disease, it is true, may thus be cured, but the patient may be killed by general infection due to the disturbance of tubercular material, and it is slight credit to have performed a successful operation on a patient who died as a result of it.

With regard to cheesy foci in bone, their precise location and number can rarely be determined, nor can it be generally known whether they should be evacuated, or if they will not ultimately disappear in the growth of healthy granulation tissue. As a rule, these should be left alone. With regard to tubercular abscesses, there are three plans of treatment;

(1) To open with or without an attempt at removal of all diseased tissues; (2) to aspirate with or without the injection of some medicament, as iodoform in glycerine or oil; (3) to leave the abscess alone for spontaneous opening or re-absorption. Clinical observation has shown that the earlier the abscess cavity opens or is incised the more surely does it lead down directly into the joint or the cheesy cavity in the bone. At that stage erasion of all diseased tissue is much easier than at a later time, but at the same time the risk to the patient in case of accidental septic infection is a very serious one. As already indicated, the course of these abscesses when left untreated is downward and away from the joint. In time the opening, leading from the joint or bone-cavity to the abscess sac, becomes partly or completely closed by granulations; even the original site of the abscess may have healed and the nearest point of the abscess-cavity may be some inches from that point or the original focus. The complete removal of all tuberculous material may now be a much more difficult process because of pockets and partly obliterated tracks, but the risk to the patients from septic infection is little. In the operative treatment of these abscesses the necessity of certain removal of every particle of tubercular membrane has been urged, but, judging from the manner in which bone-cavities and joints heal and cut themselves off from the abscess-cavity; in which the walls of the abscess-cavity close above, as the contents descend to a lower level; in which the cavities and sinuses, where there have been spontaneous openings, close when no longer leading from diseased bone; in which these abscesses disappear at times after aspiration; in which even very large abscesses at other times disappear without opening or ill effect to the health of the patient; and, judging from the results of operations, it would seem that extreme gentleness, in erasing the tubercular membrane so as not to wound the normal tissues, is of greater importance than vigor in the use of the sharp spoon. In recapitulation we may say that tubercular abscesses arising in connection with chronic joint disease are strictly aseptic; that incision, and especially early incision, is hardly ever called for; that incisions add very materially to the risk in many cases where it might be expected

to be of advantage; and that it is therefore rarely required in those cases where it can always be safely performed, and when performed the cleansing should be done with only a stream of water, using the pulp of the finger at most, to avoid all wounding of the surrounding tissues; that this gentleness is of far more importance than thoroughness of erasion; and that the wound should be closed unless very extensive bone disease be present, and then it is better left open, without any drainage tube. Abscess cavities may be aspirated, but even a moderately complete evacuation is often impossible because of the clots of fibrin which plug the needle. If successfully aspirated, they usually refill again and again until spontaneous opening, septic infection or incision ends the farce. When aspirated as thoroughly as possible and injected with a sterilized mixture of iodoform in glycerine or olive oil they close more frequently than when simply aspirated, and in closing are accompanied with more shrinking of surrounding tissues; whilst the risk from septic infection remains much the same. Left without operative interference of any kind, even large abscesses not infrequently disappear, and small ones, when the part is at perfect rest, disappear in about 50 per cent. of all cases. When spontaneous opening does occur the patients rarely show constitutional symptoms of septic infection; the abscesses run quite as short a course and heal quite as well as those that have been operated upon and have failed to close by primary union.

So-called erasion of the joint is rarely, if ever, a justifiable operation. There is no certainty that all of the tubercular material has ever been removed by this operation, and the risk of general tubercular infection is great. No better results are gained by its employment than by excision, whilst the risk is much greater.

Excision may be justifiable as a time-saving measure in the case of a laboring man, but it is often of doubtful utility then. Any case that can be cured by excision can be cured with a better functional result without it. Excision in the lower extremity means confinement to bed for not less than eight weeks, the results being a limb which will not bear the strain of severe labor for a long period, a stiff joint, a short leg,

and a very considerable risk of relapse. An equal period of rest in bed, and careful use under efficient fixation would, in our opinion, give a limb which, under such continued treatment, would prove as useful during the remaining period of convalescence as the best result of an excision; and when cured would not be materially shortened, and, in very many cases, would have motion at the joint. In adults we leave the choice of the result to the patient himself, but in children the operation should never be performed; for, in addition to the result above indicated, there remains a gradually increasing further deformity from arrest of growth, which may, when the full growth of the patient has been at tained, be so extreme as to renderthe limb wholly useless. We are inclined to believe that any joint in growing children that cannot be cured without excision, demands amputation. The best results from excision are at the elbow; so are the best results of the non-operative treatment. The next best results are at the knee, and the same holds good of the mechanical treatment. As to amputations, they are always indicated as life-saving measures; and, we believe, should never be made nearer than three inches from a joint, except at the hip and shoulder.

SPONDYLITIS.

FIG. 4.—Spondylitis of dorso-lumbar region.

Spondylitis, also called Pott's disease, spinal caries, etc., may be the result of injury, syphilis, or tubercle; or it may follow scarlet fever, measles, whooping cough, or other infectious disease, and may be dependent, primarily, upon their bacilli; but however it begins, or whatever be its specific origin, the symptoms presenting and the indications for treatment are practically almost identical, and all cases sooner or later show evidences of the presence of the tubercular bacillus. The disease may perhaps commence in any of the connective tissues composing the spinal column, but there is little satisfactory evidence to show that it ever begins elsewhere than in the cancellous tissue, or upon the anterior aspect, of the vertibral bodies. Very rarely has the disease been found so placed as to render it a fair assumption that its origin was either in the intervertebral discs, the laminæ, articular facets, or processes (fig. 5).

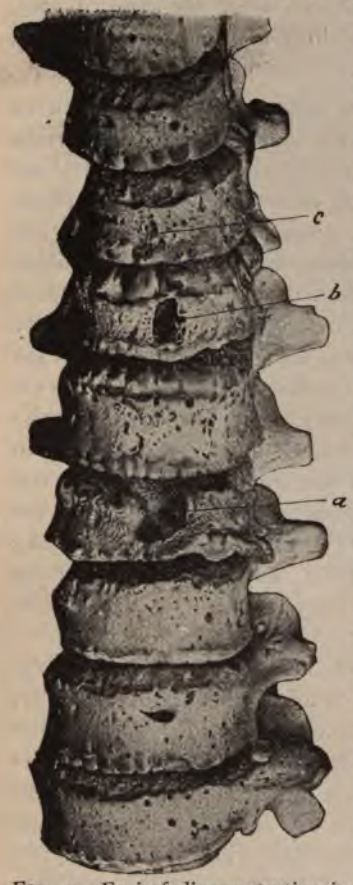

Fig. 5.—Foci of disease starting in anterior part of vertebral lobes. "Die Tuberkulose der Knocken und Gelenke" (Krause).

In traumatic cases the early symptoms vary with the injury received; the late symptoms are those of an ordinary tubercular case. Spondylitis arising without assignable cause in very young children, cases of multiple joint disease, where spondylitis is present at two points separated by one or more healthy vertebræ, or co-existing with disease at some other joint, and spondylitis in classes notoriously syphilitic, may be suspected of owing their origin to syphilis rather than to tubercle, and suitable for the administration of large doses of mercury

and iodide of potash. It is only in the improvement which follows this treatment that they materially differ from the ordinary tubercular cases. Those which follow scarlet fever, measles, etc., show no peculiarities except a proneness to early suppuration. The ordinary tubercular case presents the irritative symptoms indicative of inflammation in the vertebral bodies. These will be discussed in detail under "Symptoms."

The principles of treatment are immobilization and relief from pressure; in a word, *physiological rest of the diseased part.* The means which the surgeon employs to secure this physiological rest will be discussed under "Treatment."

Symptoms in General. — Certain symptoms are common to the disease in whatever part of the spine it may be; certain other symptoms are peculiar to the part affected, and these latter will be enumerated under their respective headings. The symptoms common to the disease in any part of the spine are as follows: The face often expresses apprehension, pain, and premature old age; the patient walks and moves with care, as if to avoid any jar or sudden movement; there is a history of uneasiness, fretting, and irritability, and, for some time, the patient has been averse to his usual active exercise, and has been easily fatigued. Distant pain in the terminal filaments of the nerves, whose motor branches go to supply the muscles which control motion of the spine at the point of disease, is generally present, though sometimes absent, as may also be restlessness, crying, and screaming during the first hours of sleep. Deformity may or may not have been noticed; and the complications, abscess and paralysis, may or may not have appeared.

For the proper examination of a patient he should be stripped naked. Girls who have reached the age of puberty, and women, should receive certain consideration, and it is the custom to examine such with the back alone bared. It is convenient to have the undershirt put on in front, as an apron, with the sleeves pinned or tied about the neck; the skirts can then be dropped to a level with the great trochanters and fastened by a piece of bandage around the hips. The back is then inspected for lateral deviation, excurvation, or prominent vertebræ. If any be found, the disease may be

suspected at the middle of the curvature; but it must be remembered that easily demonstrable spondylitis is present, usually for some months, before deformity of the spinal column is apparent. All of the normal motions should now be tested, both actively and passively; the head should be rotated to the right and to the left, the shoulders twisted in the same directions, while the pelvis is held steady by the surgeon; the spine should be bent forward and backward, to right and to left. Any portion which shows rigidity to all the normal motions is, or has been, the seat of an inflammatory process; but if there be rigidity to bending in one direction only, or if bending even in one direction be normally free, the diagnosis of spondylitis is rendered extremely doubtful. It is upon this rigidity, which for some time is due solely to involuntary muscular spasm, that the diagnosis must depend; it is ever present, both sleeping and waking, and nothing abolishes it except profound anæsthesia, and, at times, the termination of the inflammatory process. It is the first symptom to appear and the last to disappear; and when, and anly when, it is no longer present, can a cure be safely predicted.

There seems to be an almost universal belief among the profession, and this belief has been fostered by nearly all teachers and writers on general surgery, that the most early and constant—in fact, the diagnostic—symptom of spondylitis is tenderness on pressure over the point of disease. There is no lack of knowledge as to the pathological anatomy; it is perfectly well known that the lesion is confined to the vertebral bodies, and usually to their anterior portions. It is therefore quite impossible that there should be tenderness on pressure over the spinous or transverse processes. Unless, then, there be disease of the processes or laminæ, an exceedingly rare condition; or unless an abscess, which will readily be detected by palpation, be present, tenderness on pressure will not be found in spondylitis. In a doubtful case its presence must count as an important symptom against spondylitis.

Downward pressure and concussion on the head, and sudden twisting of the spine, by wrenching at the shoulders when the patient is off his guard, are tests as unnecessary as

harmful. They will not be found to be of any value in the very early period, and can scarcely fail to inflict injury as well as pain upon the patient when the disease is at all advanced.

FIG. 6.—Caries of lower dorsal spine, shewing complete destruction of one of the bodies. "Die Tuberkulose der Knocken und Gelenke" (Krause).

Sooner or later deformity of the spine appears, and a lateral curve, with or without twisting of the vertebræ (rotation), often appears before kyphosis, the so-called "angular curvature," makes its appearance. If one, two, or three vertebræ only be affected, and if the destructive process has been considerable, the deformity approximates an angle (fig. 6); but if

several vertebræ are diseased, each in only a slight degree, the deformity will be a curve.

Motor paraplegia affecting both lower extremities, at times the bladder and rectum, and occasionally the upper extremities, may come on before the bony deformity, or with the deformity, or comparatively late in the disease. It is generally due to thickening of the membranes of the cord from the contiguity of the inflammation in the bone, or to an actual infiltration with tubercular material. The pressure resulting is generally confined to the anterior columns of the cord, and sensation is rarely affected. Paraplegia occurs most frequently when the disease is in the upper dorsal region. It bears no relation to the acuteness of the angle; it may disappear while the bony deformity goes on increasing; and it has seldom been shown to depend upon bony pressure. The paraplegia is characterized by an exaggeration of all the tendon reflexes in the affected extremities, a tonic spasm of all the muscles, and an inability, more or less complete, to move any portion of the affected parts.

FIG. 7.—The head held rigid, in act of rising.

Although collections of tubercular material are alm
always found to some extent, the typical tubercular absc
does not always appear. Abscess is most frequently seen wh
the disease is in that part of the spine below the diaphrag
less frequently in disease of the cervical region, and still le
frequently in disease of the dorsal spine. The abscess m
make its way in any direction, opening externally, or into a
of the open or closed cavities of the body, or it may becom
absorbed even after it has attained very considerable proportion

FIG. 8.—Head held rigid.

Cervical Spondylitis is most frequently found in the upper two or three vertebræ. When it is suspected, before deformity has occurred, in very young children, the child should be examined by placing him across the parent's knees. If disease exists the child will not let the head dangle, no matter how prolonged the examination may be (fig. 8). If placed supine he will show no inclination to bend the head towards the sternum as in the first act of rising (fig. 7). As the disease advances deformity occurs. If the upper portion of the cervical spine be affected twisting of the head may be expected (fig. 9). With disease somewhat lower down the head is advanced, the chin dropped towards the chest (fig. 10), an angular projection of the spine at the diseased point may be felt, and

the posterior spinal muscles stand rigidly out and may simulate an abscess in appearance; when the disease is still lower down the chin is elevated (fig. 11) and relatively somewhat advanced, and the head is thrown back towards the shoulders, and in extreme cases may rest upon them. The face expresses apprehension and the head is moved, if the patient can move at all, with anxious care; he rarely tries, however, preferring to turn without distressing the diseased area. All motions, both active and passive, at the point of disease are restricted

FIG. 9.—Head twisted in cervical spondylitis very high up.

FIG. 10.—Chin thrown towards chest in disease lower down.

or wholly abolished. Pain may be complained of running up the back of the neck and head, down the arms, or in the chest. Abscess does not frequently occur; when it does it usually points on one or the other side of the neck (see fig. 11) behind the sternomastoid, or it may point in the pharynx, which need not, however, be examined unless some symptom point to abscess in that neighborhood. Before its formation the finger in the throat reveals nothing, it is very repulsive to the patient, and the normal prominence of the vertebral bodies may mislead the surgeon.

Paraplegia is seldom a complication. Occurring, it may affect the lower extremities alone, as is the rule, or the upper extremities

as well. Striking downward upon the top of the head with the open palm to test the sensitiveness of the vertebræ is a useless and a most barbarous procedure.

Dorsal Spondylitis is much more frequent than disease in the cervical or lumbar regions. Before the appearance of kyphosis the diagnosis must depend: upon the persistent distant pain, often treated for many months as gastric pains; upon a disinclination to indulge in rough play; a growing tendency

FIG. 11.—Head elevated in cervical disease. Cicatrix of abcess behind sterno mastoid.

FIG. 12.—Patient cannot stoop because of spinal rigidity.

to stand with the elbows resting on a chair or table; a grunting respiration; and upon an inability either to rise from a stooping posture or pick up an object from the floor without resting the hand upon the knee (fig. 12).

Any distant pain, which does not yield readily to the proper medication, should lead to a careful examination of the spine. Often there is crying when the child is lifted, and cough accompanying a grunting respiration. If the upper two or three dorsal vertebræ be those involved, the head may be thrown backward and the neck held rigid against forward or lateral bending; and paraplegia may even come on before any kyphosis can be made out. When the disease arises in the lower dorsal

region, the patient may limp and complain of pain in the thigh, as in hip disease, and this before any deformity is noted.

Lateral deviation of the column, with or without rotation of the vertebræ, is often present before the antero-posterior deformity appears. In very young children, before any spinal deformity has appeared, it is convenient to examine them by placing them across the separated knees of the parent. If there is disease the spine will not form an anterior curve in the normal way. If placed sitting upon a table with the knees straight, the child will not bend forward by arching

FIG. 13.—Patient rests on knees in getting up, and when fatigued.

FIG. 14.—Compulsory projection of chest.

the spine in the usual way. The patient is disinclined to forward bending, and, when picking up an object from the floor, squats with rigid spine, instead of stooping, and evinces weakness on rising, often regaining the erect posture only by climbing hand over hand up his own legs (fig. 13).

When kyphosis has appeared, however, the diagnosis will be readily made, for, in addition to the peculiar and striking deformity, all the symptoms heretofore mentioned are likely

to be found on careful investigation. Sooner or later projection forward of the chest takes place compensatory and proportionate to the angular deformity at the back (fig. 14).

Paraplegia, which is more common when disease is in the upper dorsal spine than elsewhere, may come on early before any deformity has appeared, or at any time during the course of the affection or during its latest stages, and, having disappeared, may recur again and again. It begins with exaggeration of the tendon reflexes, stumbling in walking, increasing lack of muscular control, and goes on until all control over the lower extremities is lost and the limbs are held rigidly extended; at times they are drawn up with spasmodic crampings, and may suddenly, without the patient's volition, be ex-

FIG. 15.—Showing cicatrix of healed dorsal abscess.

tended with a jerk. Passive flexion at the ankle induces marked ankle-clonus. On rare occasions the sensory nerves and, at the same time, the bladder and rectum are affected.

Abscess does not frequently appear when the disease is above the diaphragm, although it is probable that tubercular collections form to some extent in all cases; when the abscess does present, it usually makes its appearance from between the ribs, at a distance of two to four inches from the line of the spinous processes; rarely, however, it makes its way downward before appearing at the surface. In disease of the lower dorsal vertebræ the abscess usually follows the course of the psoas muscle, traveling downwards in the posterior mediasti-

FIG. 16.—Large psoas abscess connected with dorsal region.

num under the ligamentum arcuatum internum of the diaphragm, and thus passing into the psoas sheath.

Lumbar Spondylitis is less frequent than disease in the dorsal, but more frequent than disease in the cervical region. Lumbar spondylitis is usually first recognized by an awkward gait, a limp, and a slight lordosis. The shoulders are thrown backward, the foot is slightly advanced, and the patient walks with care and holds his spine rigid. He is even less inclined than in dorsal disease to forward bending. If there be pain, it is usually felt down the anterior and inner surface of the thigh. Most of the symptoms, enumerated as characteristic of disease in the dorsal region will be found present. Contraction of one or both psoas muscles may come on before the formation of abscess, and before the appearance of kyphosis. It is in this early involuntary spasm of the psoas muscle, flexing the thigh and limiting its extension, before the appearance of deformity, that leads to the mistaken diagnosis of hip disease even by experienced observers.

To test for contraction of the psoas muscle, the patient is placed prone upon the table, the pelvis is held firmly down with one hand, while with the other hand first one and then the other knee is lifted upwards. The freedom with which they can be raised, and the difference in extent of movement, or the extent to which each of them differ from the normal, must be noted. Then with one hand upon the back, at about the tenth dorsal vertebræ, and the other hand lifting both knees at the same time, the rigidity of that part of the spine is noted. It is upon this rigidity that the diagnosis must depend. In healthy children the spine can be bent backward so far that the thighs are at nearly a right angle with the upper dorsal spine.

Paraplegia is not common, owing, no doubt to the fact that below the first dorsal the dura mater only accommodates nerves. The cauda equina does not occupy so large an area as the cord itself along with the nerves, leaving it in the higher regions of the spine. When paraplegia occurs, it in no way differs from that found complicating dorsal disease. Abscess is frequent, usually following the course of the psoas muscle,

and pointing on the anterior surface of the thigh below Poupart's ligament, (fig. 16), and opposite the insertion of the muscle. When the disease is below the third lumbar vertebræ, the abscess may pass down and point in the buttock; this is due to the entrance of pus in the psoas sheath, where it is continuous with the sacral end of the pelvic fascia, and which passes down to the pyriformis, and leaves the pelvis through the great sacro-sciatic foramen; or with disease in any portion of the lumbar vertebræ it may pass laterally, following the nerves, and point in the loin some inches from the spine.

Differential Diagnosis.—A strain may give rise to the early symptoms of spondylitis; for a strain, left untreated in a tubercular subject, may become a true tubercular spondylitis. A strain, of course, carries its distinct history.

A *rachitic* spine (fig. 17) closely resembles the "rounded curvature" of spondylitis. The deformity is sometimes a rigid one, although usually in children the spine can be easily moulded into position. The curve is very rarely an angular one, but lateral deviation is more marked and more frequent than in a tubercular case. It is the most amenable of all varieties to treatment, and gives rise to no pain, nor does it ever result in paraplegia. It will be found to arise only in young children, and the child will nearly always present other evidences of rickets. The mistaking of a rachitic spine for spondylitis will, however, be of little harm to the patient, inasmuch as the rachitic spine demands a rigid support.

FIG. 17.—Rickety Spine.

Scoliosis—lateral curvature—will not be mistaken for spondylitis, as the curvature is not usually rigid, until some time has elapsed, and the deformity has become very considerable. On the other hand, spondylitis may be mistaken for lateral

curvature, and the necessary immobilization withheld and, possibly, exercise advised. A slight lateral curve with or without rotation, if it be rigid, is probably a commencing spondylitis. Exercises should be withheld and a support applied, when a few months' observation will clear up the diagnosis. Whilst pain is rarely associated with scoliosis, it is the rule in spondylitis, though it should not be forgotten that it may be absent in both. A careful circumferential outline of the chest may throw some light on the subject; in spondylitis it should be practically symmetrical; in scoliosis it very early becomes asymmetrical, bulging posteriorly on the side of the convexity of the curve and flattened posteriorly on the side of the concavity, whilst in front the conditions are reversed.

Torticollis is closely simulated at the first glance by spondylitis of the upper cervical region. Still in many cases the diagnosis can be made almost at sight. In wry-neck the chin points *away* from the prominent sternomastoid muscle (fig. 18);

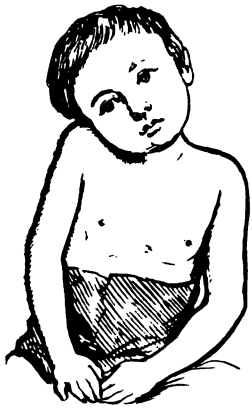

FIG. 18.—Chin pointing from prominent sterno mastoid in torticollis.

FIG. 19.—Chin pointing towards prominent muscle in spondylitis.

in spondylitis it points *towards* that muscle (fig. 19), if only one sterno-mastoid be prominent. In spondylitis the movements of the head are restricted in all directions; in torticollis only in one direction—that which puts the shortened muscles on the stretch.

Hip disease is not infrequently the diagnosis when contraction of the psoas muscle comes on in lumbar spondylitis prior to kyphosis. The patient walks with a limp, complains of pain in the groin or along the anterior surface of the thigh; the thigh is flexed on the pelvis, and attempts to overcome this flexion are resisted by involuntary muscular spasm, and give the patient pain. It will, however, be found that the thigh can be flexed to the normal degree, and that, when flexed sufficiently to fully relax the psoas muscle, rotation at the joint is free, painless, and normal. In a word, extension is the only motion at the hip joint that is limited by muscular spasm in lumbar spondylitis, whereas in hip disease motion in all directions is restricted.

The *hyperæsthetic* or *irritable* spine, if patiently and carefully examined, give no rigidity from involuntary muscular spasm. There is no true distant pain, the pain being confined to some portion of the spine itself and associated with tenderness on pressure. The lightest touch is often complained of more than firm deep pressure. The condition is most frequently found in young women, and may have existed unchanged for years. There is no true kyphosis.

Malignant disease of the spine, in its early stage, cannot be differentiated from spondylitis. The history of the case as to hereditary tendency, taken together with the patient's age and general appearance, may make the diagnosis of malignant disease probable; but nothing can be positively said until the progress of the case or the pressure of the tumour clears up the doubt.

Sacro-iliac disease is not of frequent occurrence, and its early symptoms are obscure. Muscular rigidity of the lumbar spine to bending in all directions will not be found unless the disease is associated with spondylitis of the lumbo-sacral articulation. Examination by the rectum should be made in all cases suspected of sacro-iliac inflammation.

The *typhoid spine* can of course be found only as a sequœla of typhoid fever. There is tenderness on pressure and on lateral and forward bending, no special pain in the nerve distribution, and no psoas contraction; the onset is sudden, the recovery rapid.

Prognosis.—As to deformity: In the cervical and dorso-lumbar (tenth dorsal to third lumbar inclusive) regions the deformity may, under favorable circumstances, be reduced if consolidation has not already taken place, and any further increase prevented if consolidation has commenced. If deformity has not yet occurred its appearance can of course be readily prevented, and, as a rule, a rapid cure can be effected. In the upper dorsal region, comprising six vertebræ, the deformity may be expected to increase under any form of treatment with which we are familiar. From the sixth to the tenth an increase in deformity can generally be prevented, but can rarely be reduced. When the disease affects the lower lumbar region, the fourth and fifth vertebræ and sacrum, the deformity may be expected to appear and to increase up to a certain point, unless the patient be treated continuously in the recumbent posture until consolidation is well advanced. In a word, if the spine can be made straight and kept so sufficiently long for osseous matter to deposit in the space made vacant by the disease, and anchylosis free from deformity, or nearly so, will result. In a few cases more or less restoration of the normal motion is gained.

As to paraplegia: In nearly all cases the paraplegia is due to the pressure of the inflammatory products in the neighborhood of the bony tuberculosis; in these cases recovery may confidently be expected, if the patient be kept recumbent for a sufficiently long time, when shrinking of the new material takes place on the subsidence of the inflammation. Rarely the paraplegia is due to pressure from a displaced spicule of bone, but there is no evidence that it is ever caused by the acuteness of the angle of the canal. The authors have observed complete restoration of function to the paralyzed limbs in a case where the motor paralysis had been complete for nearly four years, and partial recovery in another recent case where the sensory paralysis had existed for two and the motor paralysis for ten years. In all cases of paraplegia the surgeon is justified in making a most hopeful prognosis. Even where the patient is inefficiently treated or quite neglected recovery usually takes place. In children it is often the precursor of recovery, as it insures rest in a manner that nothing else can.

As to life: Although spondylitis is a most prolonged and serious disease, the prognosis as to life is remarkably good. Only about 8 per cent. of cases receiving proper nursing and treatment die. Of these the cause of death in nearly all is tubercular meningitis or a general tuberculosis in which the meningeal symptoms play a most prominent part.

The duration of the disease in any particular case can not with accuracy be predicted. Treatment will be required for at least two years, and may be necessary for twice or thrice that length of time. The duration of the paraplegia is generally about a year; relapses of the paraplegia may occur, but are not frequent. The lack of an early diagnosis, and of early energetic, and prolonged treatment may be considered as the cause of the marked deformity which ultimately results in so many cases.

TREATMENT may be summed up in the term physiological rest. This means the nearest possible approach to immobiliza-

FIG. 20.—Showing way to utilize an ordinary bed to enforce recumbency.

tion of the diseased area, its protection from jars and concussion, and its relief from weight-bearing until consolidation has become well established. Immobilization is sought for, and more or less perfectly attained, by rest in bed with or without traction, or by a brace or a corset; some of these devices by their leverage action protect the diseased area from a certain degree of weight-bearing and jar during locomotion. Whether the patient shall be treated by brace or jacket, or in bed with or without traction, will not only depend upon the individual case, and its personal peculiarities, but also on the family and general surroundings, and the skill of the surgeon himself in the use of this or that special appliance. One surgeon may be able to fit a brace well and manage it skillfully, but be unable to make a satisfactory plaster jacket; another may be unable to work at all with tools and yet make an elegant and well-fitting jacket. The methods of treatment are of far less importance than a true appreciation of the principles involved, and the patience requisite to carry them out to the very end. In the hands of one of the authors the best results have been obtained by the antero-posterior leverage brace; in the hands of the other a cuirass has been most serviceable. The latest form of the Taylor brace is perhaps the most correct theoretically, but in our hands it is not readily obtained and fitted. Most surgeons probably now use some form of jacket of plastic material, of which the Sayre pattern is the best known and most readily made example. Each of these will be hereafter described.

Treatment should be commenced at the earliest possible moment, and must be persisted in until a cure is effected. A case is cured only when the spine, in any posture, can bear the superincumbent weight without pain or evident weakness, and continues to do so without any increase in the deformity.

Treatment by Recumbency.—This method of treatment in its effective application is so exacting to the patient as to be well-nigh impossible. It calls for the most careful nursing, and, hence, is totally unsuited for the poorer population. It requires that the bed should be flat, smooth, firm, and without a pillow, and the patient so secured by straps that he cannot sit up, twist or turn. A strap of webbing or strong canvas

bandage should be passed across the bed beneath the patient's shoulders, and fastened to the bed frame on either side; upon this strap are strung two loops, through which the patient's arms pass, and these are connected the one with the other by a strap across the chest. The pelvis is secured by a broad belt around it, from the sides of which straps pass to the sides of the bed-frame and are there fastened (fig. 20). The patient must not be once allowed to sit up for food, for the use of the bed-pan, or for any other purpose; nor must he be taken from the bed for bathing, for changing of sheets or clothing, or for the turning of the mattress, if the best effects of recumbency are to be assured. To fail in strictly following these directions may cause the breaking up of the new bone formation about the carious vertebræ, a return or increase of the deformity, or may prolong the paraplegia, if present, and

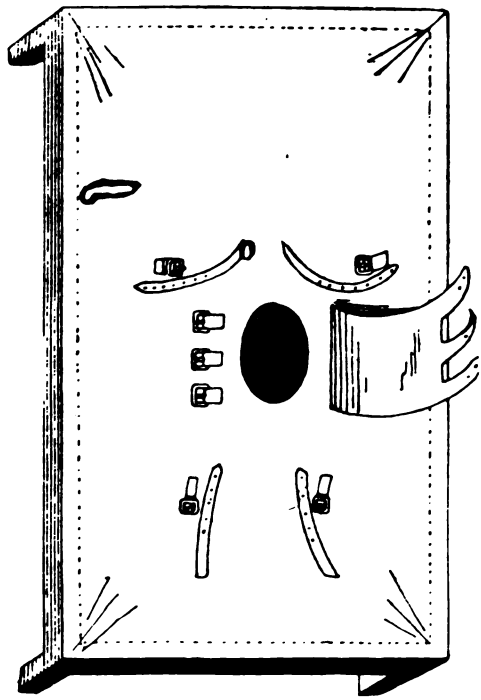

FIG. 21.—Cheap canvas bed for fixing patient in recumbent position.

perhaps render it incurable. It will be readily seen that, although the surgeon is saved labor, it is very difficult to carry out this treatment for any considerable time; in fact, practically impossible to carry it to a successful result in any but an exceptional case. "So-called" treatment by recumbency often means that the patient lies in bed when he chooses, sits up when he pleases, or gets up and walks when he can. Under such conditions it is not surprising that the deformity increases, that abscesses are frequent, and the duration of the disease prolonged.

In two cases successfully treated the little patients were strapped on canvas stretched on a frame which rested on the bed by four short legs. Straps were placed which fixed the shoulders and thighs to the canvas, and a hole opposite the

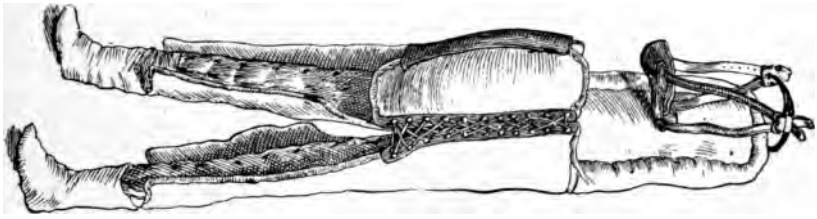

FIG. 22.—Phelps' plaster bed.

anus and perineum assured easy egress to excretions (fig. 21). By this device the patients could be moved about without interfering in any way with the diseased vertebræ. An excellent adjunct is to slightly modify a Thomas's double hip splint, by putting the parallel bars a little closer to each other, so as to restrain all action at the hip and enable the patient to be lifted or moved in one piece. Without some such plan, to turn a patient over for cleansing or other purposes means damage, severe or slight, to the carious column.

Thomas's modification of the Bauer support offers admirable assistance to bed treatment if two bars be added which extend to the knees and thus fix the thighs. This appliance is easily borne and offers no difficulty in its application. The irregularities of bed are thus obviated, and the greatest leverage can be employed to modify existing and prevent threatening deformity.

To increase the efficacy of recumbency various other means have been employed. Traction is used both for its effect in reducing the deformity and preventing the patient from sitting up in bed. A sling is attached to the patient's head and from it a cord is carried over a pulley at the head of the bed to a small weight of from a half to one or two pounds. Slings may be made of leather or cloth, and are constructed upon one of two general plans: either that which is used in the ordinary suspension apparatus (fig. 27), or one made

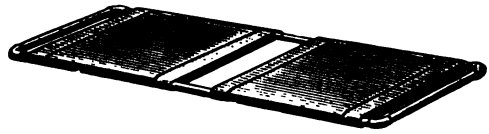

FIG. 23.—Bradford's canvas stretcher-bed.

by buckling a band across the forehead and below the occiput and attaching another above each ear to pass over the head, to which is attached the pulley cord (fig. 24). This leaves the chin free, its prolonged use does not cause recession of the chin, and in exquisitely sensitive cases of cervical spondylitis it allows the patient to eat with less motion and less pain.

Traction can be used with advantage only in cases confined to bed, being especially advantageous in cervical spondylitis, less so in lumbar and dorsal disease. It is of value where inflammation is progressive and where paraplegia complicates. It is an efficient aid in reducing to a minimum the pain and increase of deformity from muscular spasm during the formation of abscess. Traction does not appear to separate healthy articular surfaces or diseased ones after the reparative process has commenced. It does, however, at times reduce the deformity, apparently by separating the contiguous carious surfaces, and this without pain or any ascertainable untoward results.

Treatment by the Plaster-of-Paris Jacket.—This aims at immobilization after the patient has gained the position of greatest comfort by partial suspension. The opponents of the plaster jacket treatment have asserted on the one hand that, by suspension, the carious surfaces are separated and the patient's life thereby endangered; and, on the other hand, that suspension

was of no use inasmuch as it did not straighten the spine at the area of disease, but only apparently elongated it by straightening the normal curves. It appears to us that neither of these objections has any foundation in fact. There appears to be no evidence that separation of the carious surfaces by proper partial suspension has ever been of the slightest harm to the patient; and it has not been claimed by the advocates of suspension that it would straighten the curve of disease after reparative consolidation had at all advanced. Portions of curvatures and whole curvatures due to involuntary muscular spasm, and angles due to loss of bony tissue in the vertebral bodies can, before any considerable reparative action has taken place, be in a measure sometimes totally rectified by well-judged and carefully executed partial suspension.[1]

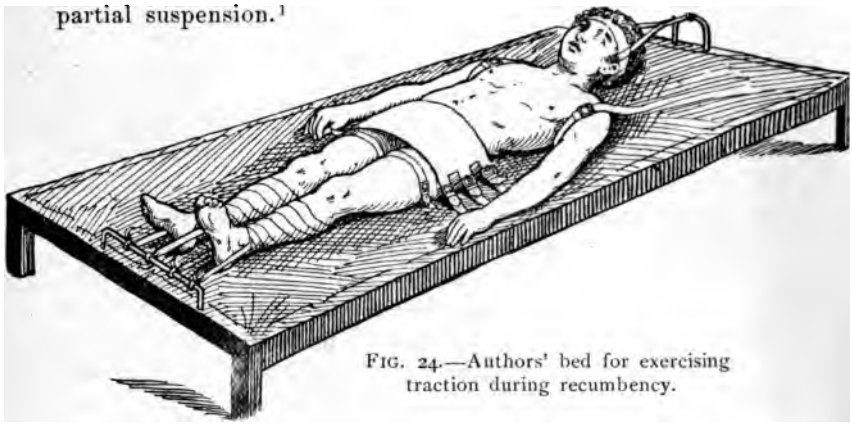

FIG. 24.—Authors' bed for exercising traction during recumbency.

The plaster jacket can, of course, be applied without suspension of the patient, but, unless the spine be put in the position

[1]When the manuscript of the part of this chapter relating to the plaster jacket was submitted to Dr. Sayre for suggestions and corrections, he told one of the authors that a patient had been killed, in Berlin, by the breaking internally of an abscess wall during *complete* suspension with weights attached to the feet and during chloroform narcosis. One of the authors can add to this by his experience in two cases, neither of which was published. He was called to see a patient who had returned home from one of the hospitals after having been suspended during the application of a jacket for upper dorsal curve. The patient, who had been perfectly well up to that period of suspension, died two hours after leaving the hospital, after complaining of pain in the limbs and suffering great respiratory difficulty. In another case paraplegia resulted suddenly, being almost complete in twenty-four hours. In both these cases suspension was too complete, although in each case a surgeon of repute superintended the application. Dr. Sayre expresses a doubt as to the possibility of fully correcting any true angle.

of greatest comfort to the patient, the object for which the plaster jacket was designed is not attained, and failure to gain good results should not be accredited to the jacket treatment. Surgeons are much too prone to modify methods and mechanical appliances before duly appreciating the principles of the apparatus which they ingeniously "improve" and attach their names thereto. It is safe to say that of the thousands who have used the plaster jacket in the treatment of spondylitis,

FIG. 25.—Moulding patient into position of least deformity, prior to fixing with plaster.

very few have ever given due thought to the teaching of Dr. Sayre to "suspend the patient until the point of entire freedom from pain is reached, stop there, and at once apply the jacket." In this connection, however, it must be remembered that many patients do not complain of pain even during the period when the angle is on the increase.

Some very young children are frightened by suspension,

and in their case it seems wise to forego its use until a certain degree of confidence has been established; in a few cases it is not well borne, the patient showing such a tendency to syncope that one does not like to repeat the experience. In such cases, prior to fixing with plaster, the hammock of Davy may be employed, or the patient may be placed in the hand-knee posture (fig. 25), and the spine guided into the best possible

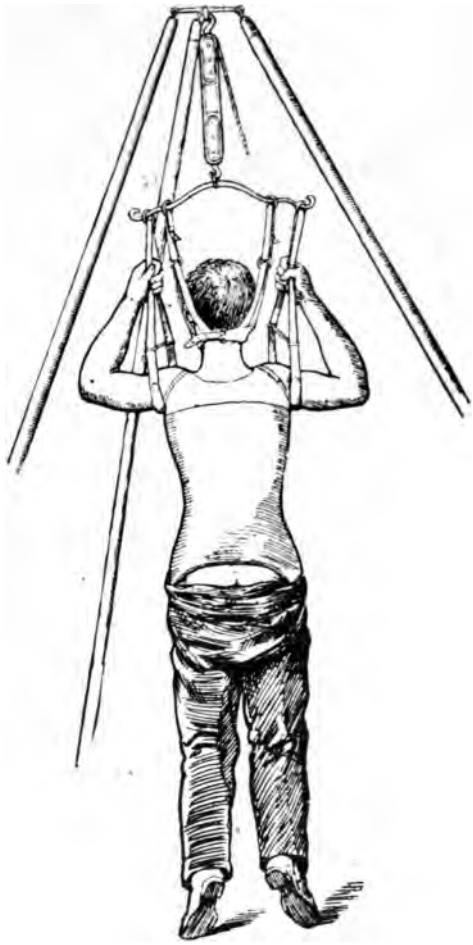

FIG. 26.—Jacket applied and trimmed.

position by gentle manipulation. If the hammock of Davy be used it must be drawn tight, otherwise the sagging as the patient lies with the face downward will give an uncomfortable position when the jacket has set and the patient stands.

The appliances requisite for suspension are as follows: a strong hook set into a beam, a tripod, (fig. 26) or crane; to the hook is attached a block and tackle; the block and tackle supports an iron cross-bar from twelve to eighteen inches long, grooved transversely for adjusting the leather head-sling, or

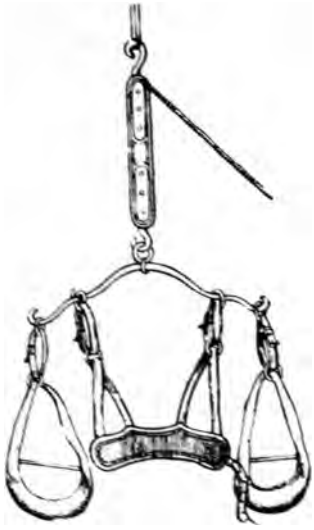

FIG. 27.—Blocks, pulley, etc., for suspending patient.

collar, and arm-slings which hang from it (fig. 27). The collar and arm-slings are so adjusted upon the patient that, when he stands directly under the cross-bar and traction is made upon the pulleys, the force is divided equally upon the head and arms.

For the jacket the plaster bandages should be made by the surgeon or under his immediate supervision, for we know of no place where even fairly good ones can be purchased. They are made from cross-barred muslin, in three yard lengths, torn into strips two, four or six inches wide, according to the size of the

patient, care being taken to tear off the selvedge from the fabric[2].

Spread the strips of muslin upon the flat surface of a table or shallow tray and rub thoroughly in the best quality of dental plaster of Paris, rubbing off the excess, and rolling the bandage rather loosely as the plaster is rubbed in. A bandage rolled tightly requires too long a time to become thoroughly wetted, while the centre of one rolled loosely and with too much plaster between the rolls easily slips when wetted and becomes twisted and tangled. Too much plaster between the rolls of the bandage is a very common fault, and needs to be guarded against. It is our experience that bandages made in any other way and from any other material, however satisfactory for ordinary plaster splints, will be found of little use for making really durable plaster jackets. From seven to fifteen bandages will be required to make a jacket: if the jacket is to be cut down and laced it should not be made too thin. For soaking the bandage use a pail with sufficient tepid water to cover, by two or three inches, the widest bandage when standing on its end. It will not be necessary to add salt or alum to the water to hasten the setting, nor to use the water too hot. The plaster sediment left in the bottom of the pail, where the bandages have been soaked, should not be used to rub into the jacket, as it will greatly delay the setting of the plaster and even soften that which was already set. A competent assistant is of the greatest importance, one who is not too ignorant, too careless, too lazy, or too conceited, to rapidly and carefully smooth out every wrinkle and rub well in every layer as it is laid on.

The patient should be clothed in a seamless skin-fitting knitted vest, made long enough to reach below the middle of the thighs, and pulled well down; it should fit without a wrinkle or a loose place. All other clothing should be removed down to a level with the great trochanters.

If the patient be a female, removable pads of cotton wool of the proper size should be placed between the breasts and the shirt; and if the jacket is to be made removable a strip of zinc

[2]The starch used in the stiffening of the muslin in no way interferes with the setting of the plaster, but specimens of muslin appear to have glue in the "sizing," and this prevents the plaster from hardening sufficiently rapidly. Such bandages should be washed and ironed before using.

or tin, two inches wide and long enough to reach from the neck to the pubes, should be placed under the shirt for protection to the patient when rapidly cutting off the jacket. A folded towel may be placed under the shirt for a dinner-pad, and others round the chest to give full room for respiration when they have been removed after the completion of the jacket, but a good dinner is by far the best dinner-pad, and a full inspiration will generally give sufficient room for respiration. On the outer side of the shirt, pads of felt should be placed over the iliac crests, and long narrow slips along each side of the spinous processes included in in the kyphosis. The floor should be covered with a sheet; and two chairs placed for the use of the surgeon and his assistant.

Now, all being ready, the patient should stand beneath the suspension apparatus while the surgeon adjusts the collar and arm slings, and suspends him to the point of comfort, and *no further*. The assistant sits in front and grasps with his knees the thighs of the patient and steadies him; the surgeon sits behind, places a bandage on end in the pail of water and waits until the air-bubbles cease to rise; he then puts in a second bandage, squeezes out the superfluous water from the first, and rapidly and smoothly winds it around the patient's waist, and from there works downward over the iliac crests to a level with the great trochanters; then he works upward again, each turn of bandage overlapping the former by two-thirds of its width, until a point is reached at the back and front well above the level of the axillæ. The assistant must smooth out all folds and rub each layer well into the preceding one. In this way the bandages are laid on until a sufficient thickness has been attained. Then with a well sharpened knife (fig. 28) the jacket is trimmed out under the arms and at the flexures of the thighs, so that the patient may afterwards sit with comfort.

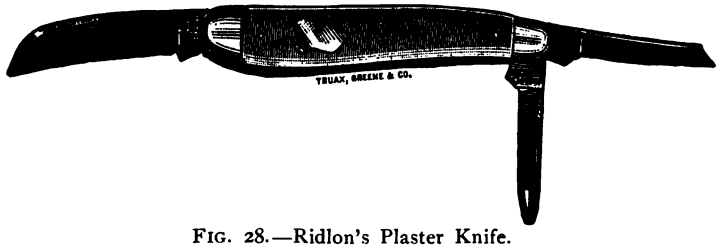

FIG. 28.—Ridlon's Plaster Knife.

By this time the jacket will usually have become sufficiently hard to permit of a discontinuance of the suspension. The patient should then sit quietly until the setting of the plaster is quite complete. If the plaster sets slowly, or if for any reason the time of suspension has to be shortened, the surgeon, placing his hands under the patient's arms, lifts him while the assistant, after removing the collar and arm-slings, supports the patient by the thighs; thus he is placed prone upon a couch to await the completion of the work. But if the jacket is to be made removable (fig. 29), it is cut down from neck to pubes, while the patient is still suspended, carefully sprung off the patient, its cut edges brought accurately together and held by an ordinary gauze or muslin roller bandage. The jacket is then set aside to dry—it will usually take two or three days—or it may be rapidly dried in an oven or over a range, in which case it must be carefully watched lest it become brittle. When dry it is tried on the patient during partial suspension, and trimmed wherever it may be necessary to render the patient quite comfortable; the outer and inner lays of the shirt are stitched together over the cut edges in front on either side, and here on each side on the outer surface of the jacket are sewn two strips of strong leather, previously provided with lacing-hooks set at intervals of about an inch. The patient is then clothed in a well-fitting undervest,—those made to measure and from Angola wool, and skin-fitting are the best—suspended as before, and the jacket applied and laced. The jacket must not be removed at night, or at any time except during partial suspension and in the presence of the surgeon.

FIG. 29.—Laced plaster corset.

For disease above the eighth dorsal vertebræ, the jacket alone does not give sufficient support to prevent the steady progress of the deformity. When the disease exists between the first and eighth dorsal vertebræ, a jurymast should be used to support the

weight of the head, and more especially to prevent it from drooping forward.

The jury-mast consists of strips of tin, perforated alternately in opposite directions, and joined to two steel uprights, at the back, bent to fit the outline of the patient. The tin strips, two on either side for a child and three for an adult, extend laterally from the posterior steel uprights nearly to the median line in front, but not across the spine, and with the posterior steel bars are worked in between the layers of the jacket during the process of its construction. The posterior bars are curved at the top, approach each other and joined into one by being welded to form the upright bar which passes upward over the top of the head. This bar is bent to approximately follow the contour of the neck and head, and may be lapped and fastened with screws so as to be elongated at will. It ends directly over the top of the head, and to its upper surface is riveted a cross-bar turned up at the ends from which depends the head-sling. The cross-bar being riveted by a single rivet, loosely set, the patient is able to turn his head from side to side at will (fig. 30).

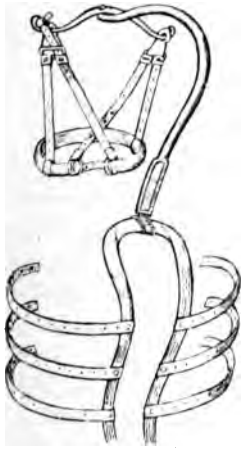

FIG. 31.—The jury mast.

For disease in the cervical vertebræ it is customary to make use of the same appliance, but the authors have not found it to immobilize effectively.

No patient after the application of a permanent jacket should ever pass from the surgeon's immediate control before twenty four hours have passed in perfect comfort; any complaint of it hurting at any point, then or later, should be considered a positive indication for the removal of the jacket.

The objections which may be urged against the plaster jacket are chiefly its cost and the delusion which most surgeons labor under that it is a simple thing to properly apply it. It will be evident from the foregoing that it is not the ideal treatment for dispensary work, where little time can be devoted to each patient and where every detail of cost is counted. A really good jacket

will last from two to three months, if a laced one, or somewhat longer if permanent, but a growing child will require from four to six jackets each year, while the disease will require treatment from two to six years. When to this we add the cost of materials, and of the surgeon's time, we can readily understand that, instead of being a cheap, it is a very expensive application.

Of course any form of treatment is cheap, when compared with another, if it gives greater freedom from suffering, a better result as to deformity, and effects a cure in a shorter time; but be this as it may, and however cheap comparatively, it will be evident to anyone that this form of treatment is not within the reach of the majority of folk.

Grave objections, however, may be urged against plaster jackets improperly applied, as it seems to us they usually are; our observations being based upon patients wearing jackets applied at hospitals and dispensaries and by the family doctor. With few exceptions they have been permanent jackets, seldom padded, and never with felt, over the bony prominences, rarely carried high enough or sufficiently low, generally so loose that a hand can be readily passed under them, so lacking in power to immobilize that the patients give a history of a steady and progressive growth of the deformity, and, when used among those of our fellow citizens who have with reason been called the "great unwashed," have formed the pleasantest of homes for vermin of various sorts.

One does not, of course, have the opportunity to remove jackets applied by others from those patients who have done well and are satisfied with the treatment; but from the other cases, those who have not done well and are not satisfied, jackets are rarely removed without pressure sores being exposed.

In very young children the pelvis is not of sufficient size, as compared with the waist, to support this jacket. This, however, is remedied by pressing the jacket laterally at the waist line before it hardens; but in these cases it will generally be found better to use one of the forms for portable recumbency.

When disease is in the lower dorsal spine a certain compensatory projection forward of the chest takes place, which is an advantage to the patient, inasmuch as it increases the chest capacity otherwise restricted (fig. 14). The jacket acts to re-

strain the development of this forward projection, even to a greater degree than it restrains the development of the kyphosis. That full respiration is restricted by the jacket is unquestioned; that this is an advantage in the region of the disease is also unquestioned; but on the other hand the abdominal respiration in upper dorsal disease we think is a disadvantage.

We have expressed the opinion that properly executed partial suspension is harmless, but when improperly executed and frequently repeated in the application of jackets it may very readily delay the process of repair. This raises the question as to the relative advantages of correcting the deformity in joint diseases by repeated efforts, or correcting it at once, or not attempting to correct at all. We believe that a repeated change in the relation of the diseased surfaces invariably delays the reparative action. Whether this as applied to the repeated partial suspensions for the application of the jacket in spondylitis is to be the great or the small evil must be decided in each individual case.

Treatment by the Antero-Posterior Leverage Spinal Brace.—It is not necessary to describe the original Taylor brace, as it is no longer in use. The modifications of this brace by Dr. Taylor have all been designed to increase its efficiency, those introduced by others have generally been to reduce its cost, but the principles upon which they have all been used are the same—namely, immobilization of the spine at the area of disease by adjustable leverage, using the transverse processes of the vertebræ included in the kyphosis as a fulcrum. Braces had been made before and have been made since the Taylor brace was devised, whose general contour are very like it, but they either differ from it in separating the parallel upright bars so far that the leverage is brought to bear upon the ribs, or they have attempted to combine extension with leverage and have thus failed to effectively apply the principle of making the leverage adjustable.

By adjustable leverage, in the treatment of kyphosis, it is meant that the brace is so constructed that by manipulating the bars by means of wrenches (at first it was by hinges and set-screws), the pressure over the transverse processes of the vertebræ composing the angle can be adjusted to a nicety and increased or diminished at will, it being anticipated that, in certain

cases and with disease in certain localities, the curve will gradually diminish, and, on rarer occasions, be entirely effaced by the leverage action.

It will be seen that the principle is essentially different from that upon which the plaster jacket is used. It does not suspend or partially suspend the patient, to gain the position of greatest comfort, which generally improves the curve, but applies the brace to the patient with no attempt at improvement in his posture beyond that which is gained by lying down for a short time. More often than otherwise the patient is not kept recumbent for more than half an hour, and at times when the disease is in either the lumbar, or in the upper dorsal, or the cervical region, the brace is applied with the patient standing. This, however, is contrary to the teaching of Dr. Taylor, who never permits the patient to stand either during the application of the brace, or afterwards, until convalescence.

The brace being applied, the chief aim is to immobilize the area of disease until a cure is effected; meantime, if consolidation has not already taken place, it is attempted by gradually increasing the pressure to straighten the curvature, or at least check the progress of the deformity. The plaster jacket aims at preserving the reduction of deformity gained by periodical partial suspension; the brace by its continued leverage action is used to reduce the deformity; both primarily aim at immobilization.

The advantages of the leverage brace, over and above the efficiency with which it carries out the principles involved, are its comparatively small cost, its durability, and the little time and effort required of the surgeon to adjust it. A gunsmith, locksmith, or blacksmith of average ability can, under surgical supervision, be trusted to make it, and the result will be a more efficient apparatus than can be obtained from any of the great instrument shops. Braces with hard rubber pad-plates and bearings will cost considerably more than if the rubber pieces be omitted, as the shaping of these hard-rubber pieces requires specially constructed moulds and consumes much time. The brace, except when these pads be added, can be generally fitted in a few minutes, it does not require frequent modifications when once properly fitted, and rarely requires repair or material alter-

ation; it is comparatively light, cool, and easily kept clean and free from vermin, and the patient can, while recumbent, have it removed without risk and enjoy the pleasures of a sponge bath. To be sure it requires a certain degree of mechanical knowledge to rapidly and perfectly adjust it, but it appears to the authors a less difficult proceeding than to properly apply a plaster jacket.

The objections to the brace are: that it is difficult to fit over a large kyphos; when disease is present with much deformity in the upper dorsal and cervical regions; and even more so when any considerable lateral deviation exists; that the prolonged use of the chin-piece may cause some recession of the chin; and that it makes no provision to prevent forward bending of the spine above and below the area of disease.

This brace is not an apparatus that can be bought ready made at any instrument makers; it must be made for the individual and with a definite end in view. We have never seen a properly made brace of this kind in any of the large instrument shops, and it is scarcely possible with the most constant supervision to get one made there accurately. It must be made from measurement and pattern. A tracing is taken with a flexible metal tape along the line of the transverse processes—the line of the spinous processes always show a much greater curve—the tracing is copied upon strong paper wherein is to be noted the position and direction of the shoulder-pieces, the place of the cross-pieces and of the pad-plates, whilst the length of the hip-piece and its curve are given.

This dirgram is the guide for the instrument maker. The resulting brace should accurately follow it, but it usually requires a little re-fitting, which is accomplished by gradually bending to the exact position with a pair of wrenches made for the purpose, or with an ordinary pair of monkey-wrenches. The pad-plates must be made to accurately fit the surface upon which they bear, and the remainder of the brace to approximately follow the outlines of the back. The test of an accurate fit is a pink pressure-line upon the skin for the full length of the pad-plates after the brace has been worn, but with no place showing that the pressure is sufficient to create discomfort or to cause sloughing. The brace should be removed every day by the attendant while the patient is prone, the back should be washed, rubbed with equal

parts of spirit and water, and when dry dusted with some good talcum powder, or a mixture of zinc oxide and starch. The brace should not be removed at night before the patient is convalescent.

The form of brace now used by Dr. Taylor and his son, Dr. Henry Ling Taylor, consists of two parallel upright bars, one cross-piece, two shoulder-pieces, a hip-piece, a chest-piece, an apron, and the necessary straps and buckles (fig. 31).

Each of the parallel upright bars consists of three parts: a pad-plate forged from steel, an upper and a lower steel bar with a transverse groove filed on one side at the end and made to fit between the flanges of the pad-plate under the cross-bar, and when screwed on forming a false hinge.

This false hinge is situated opposite the angle of deformity, and the pad-plates extend well above and below the area of disease; the lower sections of the parallel upright bars extend to a point just above the posterior superior spines of the ilium, the upper ones extend to the base of the neck, and in cervical disease to the upper portion of the neck. These uprights are joined at the top by a short cross-piece; opposite the lower border of the axillæ is another cross-piece extending two-thirds across the back, and provided with buckles at the ends; at the bottom they are attached to the hip-piece. This hip-piece is forged from steel to the shape of an inverted U. It extends across the back above the posterior superior spines of the ilia, and then curves down to the fold behind the trochanter on each side. At each end of the hip-piece is a bearing pad of hard rubber, where a buckle faces downwards, and another laterally. Across the buttocks at about the beginning of the anal fissure a broad strip of webbing is buckled, which passes from one side of the hip-piece to the other. Between the axillary cross-piece and the hip-piece, equi-distant from these pieces and from each other, two buckles are attached to each upright and face laterally. The bearing surfaces of the pad-plates are lined with hard rubber plates moulded to fit the contour of the spine. The shoulder-pieces are of steel, attached to the uprights at such an angle that they may pass across the shoulders close to the root of the neck, terminating somewhat above the clavicles in straps which pass downward to buckle on the chest-piece.

The chest-piece consists of two ear-shaped or somewhat triangular pieces of thin sheet steel faced with hard rubber, shaped to fit the contour of the chest below the clavicles and in front of the shoulders, and joined by a steel bar lapped and screwed so as to be of adjustable length (fig. 32). From the lower end of each ear-shaped piece a webbing strap passes downward to a buckle at the end of the hip-piece. The apron, which holds the whole apparatus in place, is made from two thicknesses of twilled muslin, and reaches on each side to the posterior border of each axilla and from the trochanter to the arm laterally, and is secured to the apparatus by straps and buckles.

When the disease is situate above the sixth or seventh dorsal vertebræ the head-piece is always attached, as shown in fig. 37.

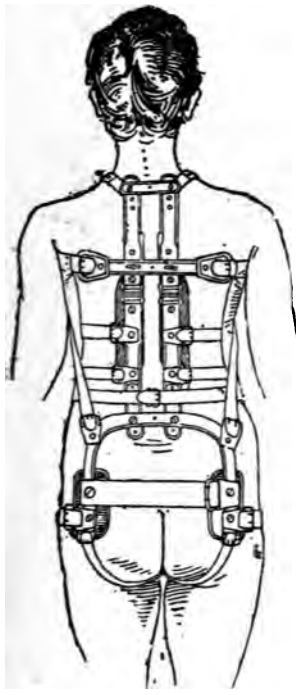

FIG. 31.—Dr. H. L. Taylor's support.

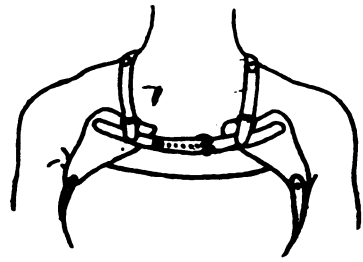

FIG. 32.—Showing ear shaped chest-pads.

An inexpensive modification of this brace is that used at the Children's Hospital in Boston (figs. 33 and 34). It consists of two upright bars of steel joined to a curved steel bar at the top and another at the bottom. The uprights are bent to fit the contour of the spine. The curved pieces are so forged that the upper fits around the base of the neck and the lower follows the same lines as, and is identical with, the hip-piece of the Taylor brace just described. The brace is lined, as shown in the illustration, by riveting to it on the surface next the patient, pieces of stiff, smooth leather, known to the trade as truss leather. Buckls are put on at the points indicated in

the illustration. The apron differs somewhat from the Taylor apron already described; laterally it reaches from the great trochanter on each side to the axilla, and thence curves around to the front of the shoulder to the level of the base of the neck; from the upper corners straps extend and fasten to the shoulder-pieces. This arrangement is intended to act as a substitute for the chest-piece. The chin-piece is an ovoid ring, hinged laterally on one side and hooked by a clasp on the other. It is fitted

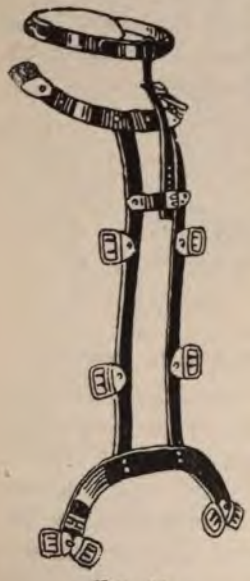

FIG. 33.

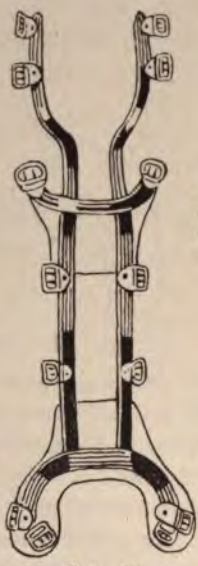

FIG. 34.

FIG. 35.

with a chin rest in front, and an occipital rest at the back, which are made of hard rubber or stiff leather. This chin-piece is provided with a hole at the back which fits on an upright pivot and permits of lateral horizontal motion; or it may be made fast by a set screw.

The form of antero-posterior leverage brace, which the authors have generally used, is shown in figs. 35, 36 and 37. It consists of a hip-band, two parallel uprights, two cross-pieces, two

shoulder-pieces, and two pad-plates. The hip-band is made from sheet steel; it is from one and a half to two inches wide, and made of two pieces riveted together; the longer piece reaches from a point, just above one great trochanter, across the back to a similar point on the opposite side; the shorter piece is half this length, lies upon the middle half of the longer piece, and is riveted to it, at the middle and at each end, before it has been bent, as later on it must be, to fit the outline of the hips. This arrangement gives a straight middle two-fourths more rigid than the same thickness in one piece would be, and an easily bent one-fourth at each end. At about an inch from each end a hole is bored for the attachment of a buckle; and at each side of the middle three pairs of holes are bored for the attachment of the uprights. These holes are usually cut with screw-threads, so that the uprights may be screwed on; they may, however, be riveted. The hip-band is lined on the side next the patient with felt, and, the whole covered with leather. The uprights are made from annealed steel, eight, nine, or ten-sixteenths inch wide, and gauge

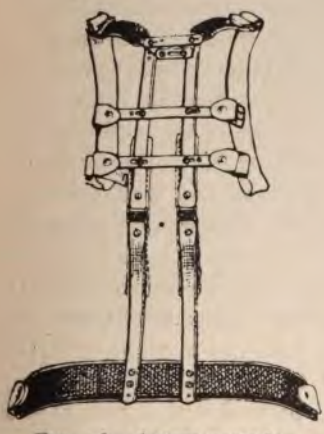

FIG. 36.—Antero-posterior leverage brace.

FIG. 37.—Antero-posterior leverage brace, with chin-piece.

nine, ten, eleven, or twelve in thickness, according to size of patient. They are each pierced with three holes at the bottom, each hole somewhat elongated and separated from the next by the same distance as the holes in the hip-band. By this arrangement the brace can be lengthened or shortened half an inch. The pad-plates may be simply screwed on—holes having been pierced—or the arrangement of the pad-plates may be the same in detail as that shown in fig. 31. In any case, the holes through the uprights, for screwing on the pad-plates, should be elongated to allow for easy fitting after any change in the curve of the

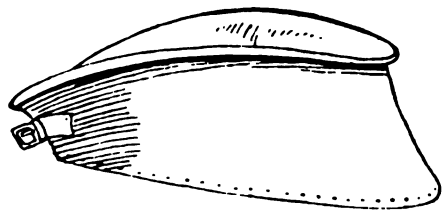

FIG. 38.—Thomas' Collar.

brace. A hole is made in each upright at a point opposite the lower angle of the scapula, for the attachment of the lower cross-bar, and another pair of holes, opposite lower borders of the axillæ for the upper cross-bar. At the top of each upright two or three holes are bored for the attachment of the shoulder-pieces; if they are to be screwed on and made adjustable, as is customary when no chin-piece is used, screw-threads must be cut in these holes; when a chin-piece is used, the shoulder-pieces are riveted on. The pad-plates serve to strengthen the brace at the part of greatest strain; if the false hinge is not required, they are cut from sheet steel the same width as the upright bars and of a length sufficient to reach well above and well below the kyphosis; they are pierced around the border with numerous holes for sewing on the pads, and, at about an inch from each end, a hole is bored and cut with screw-threads for receiving the screws which pass through the uprights. The cross-bars of steel are somewhat thinner and narrower than the main uprights; in length, they extend for an inch or two to each side of the uprights when in position. They are pierced with a hole at each end for buckles, and with three holes on one side and a slot on

the other to allow of separation or approximation of the uprights. In putting on the buckles the rivet should pass from without inward, first through the leather and then through the steel, and be hammered into the hole in the cross-piece instead of being set into a bur.

The pads which are to be sewed on to the pad-plates are small bags of canton flannel, filled with powdered cork and quilted flat to about three-fourths of an inch in width and three-eighths of an inch in thickness. Good pads, however, may be cut from piano

FIG. 39.—Thomas' modification of the Bauer cuirass.

felt. The shoulder-pieces are thinly padded on the side next the patient and covered with leather; at the end of each a tab of leather is riveted, and to these the shoulder straps are sewed.

The shoulder straps may be of webbing covered with flannel, but are better when made from a roll of blanketing or thin felt and covered with canton flannel, and terminating in a short piece of webbing, which buckles to the lower cross piece. The apron is made of two thicknesses of twilled muslin, and reaches from the lower part of the abdomen to a level with the axillæ in front, and from the crests of the ilia to the axillæ laterally. Across the bottom is sewed a strong strap of webbing covered with flannel, which fastens to the buckles of the hip band on each side. At each of the upper corners of the apron a piece of webbing is sewed in between the thicknesses of the muslin, and these pieces fasten to the buckles at the ends of the upper cross-piece.

FIG. 40.—Showing cuirass before it is covered with leather. (Photographed on a tripod.)

Between the top and bottom straps two or three others are sewed in along each side; all of these on one side are provided with buckles, to receive those from the other side when fastened around patient and brace.

When the disease is situated at or above the seventh cervical vertebræ, the chin-piece is used (fig. 37). It differs from that before described only in substituting, for the hard rubber occipital rest, two padded strips of sheet steel running up the back of the head, as shown in the figure. These are screwed to the chin-piece. At times, when the neck shows a marked tendency to deformity from spasm of the muscles, a strap of webbing is passed from the top of these occipital rests around the forehead, and buckled.

When disease is situated in the upper dorsal region it is usually not necessary to restrict the lateral motion of the head; but, when the cervical region is involved, it is customary to insert a set-screw in the socket of the chin-piece where it fits over the pivot, by means of which movement is prevented. In such cases of cervical disease, as present a very great lateral deviation and twisting, it may be impossible to fit the chin-piece with the pivot as described. The question then arises whether it is wiser to treat the patient as an ambulatory case or not. If the patient is to be permitted to walk about, a ball-pivot should be substituted for the ordinary pattern. The ball-pivot, however, is a very expensive addition, and very quickly gets out of repair, and it is our practice to reduce, if possible, the deformity at once and apply the Thomas collar (fig. 38), which is a cheaper, simpler, and a more efficient apparatus; or, if the deformity cannot be reduced satisfactorily to admit of this, to use traction in the horizontal posture for a short time, until the deformity can be overcome.

Treatment by Thomas's Modification of Bauer's Cuirass.—The treatment by this appliance is based upon the principle of immediate and complete immobilization of the diseased area by an apparatus applied in most cases to fit the deformity, without any effort, then or at any time, to correct the deformity by suspension or posture, and only very exceptionally by leverage (fig. 39.) The principle logically obtains from the theory that a diseased joint recovers quickest when subjected to immediate and com-

plete immobilization, and is injured and delayed in its ultimate recovery each time the surgeon succeeds in reducing the deformity.

The brace consists of an irregular-shaped frame of flat bar iron forged into the required form, as shown in fig. 40. At the bottom it reaches to the level of the great trochanter; that is to say, it extends as low as the sitting posture will allow. Laterally it extends from the space posterior to the great trochanter on each side, and from there curves upwards passing to the outer side of the posterior superior spines of the ilium; thence inwards to the immediate neighborhood of the spinal column in the dorso-lumbar region, from there curving somewhat outward towards the posterior border of the axilla, then upwards and inwards to the back of the shoulders, at such distance as not to interfere with the movements of the arms, till the root of the neck is reached when the two sides join in a horizontal upper bar. The width and thickness of the bar-iron used will depend upon the size and weight of the patient, thus for a child of four to eight years it should be three-fourths by three-sixteenths of an inch. In forging the frame it is made to lie flat with some accuracy upon the patient's back. This frame being in one continuous piece and nowhere pierced with holes, gives a great degree of rigidity for its weight (fig. 40). Under it is placed a piece of fairly rigid leather cut to the same shape as the frame, but extending beyond its margins, as shown in fig. 20. Again, under this is placed a sheet of saddler's felt extending a little beyond the borders of the leather piece. The felt and leather are sewed together, and to these are fastened the necessary straps and buckles. The whole is then covered with basil leather (fig. 39). From the bottom of the brace a broad leather strap, lined with felt, buckles across the front of the patient, and secures the brace to the pelvis. At the lower lateral curves of the frame, on each side a buckle faces downward to accommodate a perineal strap, which in front passes up to a buckle on the broad leather strap just mentioned. Above, at the junction of the neck and shoulder, a buckle looks forward and, at the lower border of the axilla, another looks laterally on each side; these are for the shoulder straps. The shoulder and perineal straps are of leather padded with felt and covered with basil leather.

From the middle of the brace on each side a strap of webbing two inches wide passes over the stomach of the patient and buckles. The position of this strap is changed with the necessities of the case, and at times a second strap is added (fig. 41).

Should the deformity be an extensive one and the angle formed by the spines of the diseased vertebræ be acute, one of two, or both procedures may be necessary. The leather between the frame and over the kyphos may have to be split, so that no pressure is exercised over sharp projecting bone. Again, in addition, a bar of iron may be so placed over the projection as to render the recumbent position easy (fig. 42).

In exceptional cases, where the superincumbent spine falls considerably forward, traction is made by the shoulder straps

FIG. 41.

towards the cuirass, which, in such cases, in order to allow of a pull, is not fitted accurately to the upper portion of the back. In lumbar disease, or where there is psoas contraction, a leg piece is added ending close above the knee to prevent movement of the limb and traction upon the vertebræ (fig. 43). One of the authors uses this support largely. It is comparatively cheap and cleanly. It can be removed at intervals while the back is cleansed, and a sheet of cotton wadding inserted between the support and skin. It need not be removed oftener than twice a week. This cleansing should always take place while the patient lies on his face with arms outstretched above the head. The special value of this support consists in the length of the spine which it controls. It reaches the seventh cervical vertebræ above, and by its action on the shoulders partly governs the upper dorsal vertebræ, while below it extends to the trochanteric regions and is there assisted by groin straps. There is no undue pressure upon chest or muscles, and, with care, no danger of

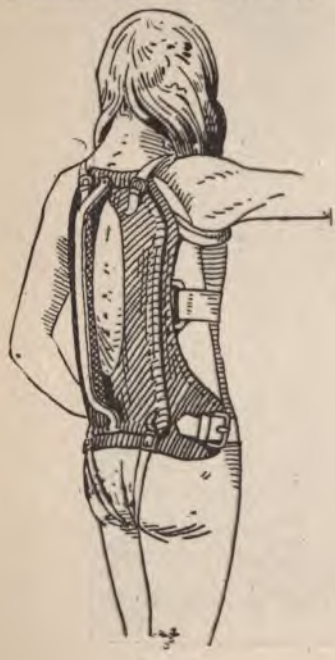

FIG. 42.

FIG. 43.

sores or excoriation. It is easily worn and is never uncomfortable and in no way interferes with recumbency.

In order to measure for the splint the patient should be placed in a sitting posture upon the chair and the distance measured from the seventh cervical vertebræ to the chair. The measuring tape should not follow the contour of the back, but take the direction shown in the dotted line A B (fig. 44). In addition the shape of the kyphos is taken and noted by means of a flexible metal tape (fig. 45).

In disease high up where the collar is required it is well to cut out for the instrument maker a pattern in brown paper something like the old fashioned stock. Unless this be done it is very difficult to secure an accurate fit, as the position of the head and neck varies so much in different cases. Where there is any doubt on the part of the surgeon as to his being able to measure properly for a collar, it is well to order one filled with sawdust, which can be modified as to size and moulded as to shape to suit the particular case.

When disease is in the upper dorsal region, a Thomas collar may be added and buckled (as shown in fig. 40), or any of the head-rests and chin-pieces, already described, may be attached to the upper portion of the frame.

The absence of holes, screws, and rivets, renders the construction of this brace simpler than the Taylor brace or any of its modifications, and while the patient is confined to recumbency it will be found more comfortable.

Other mechanical devices used only in treatment by recumbency.—While all cases of Pott's disease are greatly benefited by a longer or a shorter period of treatment in the recumbent posture, not a few absolutely demand this rest for the relief of pain and muscular spasm incident to jars from locomotion and movement. In a word, there are a certain number of cases, even when treatment has commenced before any considerable deformity has appeared, that will grow progressively worse, under the most careful bracing, unless the patient is placed for a time in bed. In certain other cases, especially in those presenting lateral and rotary deformity, there is little hope of materially correcting or reducing the deformity except recumbency be maintained fo many months. In certain other cases with abscesses or sinuses

unfavorably located for the effective adjustment of apparatus, and in all cases of paraplegia, recumbency is imperative often for months, sometimes for years.

Of the mechanical devices already described the cuirass will be found the most convenient for the surgeon and the most comfortable for the patient during the period of recumbency.

Of other devices the Thomas double hip splint (fig. 46), or as modified by Krohne Sesemann, of London, will be convenient, comfortable, and efficient. It is especially of advantage when the disease is low down in the spine and complicated with psoas contraction.

For the sake of the additional advantage of traction, Sayre uses the wire cuirass with head sling and traction from the feet; this apparatus cannot be readily obtained and is expensive. Steele, of St. Louis, accomplishes the same end by a portable stretcher-bed consisting of a forged oblong frame of flat bar-

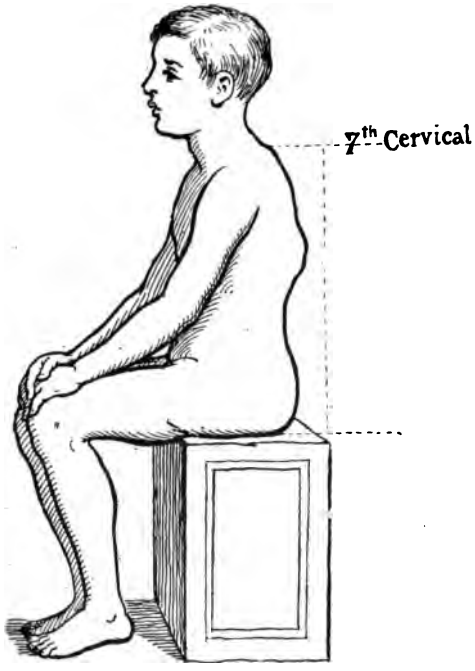

FIG. 44.

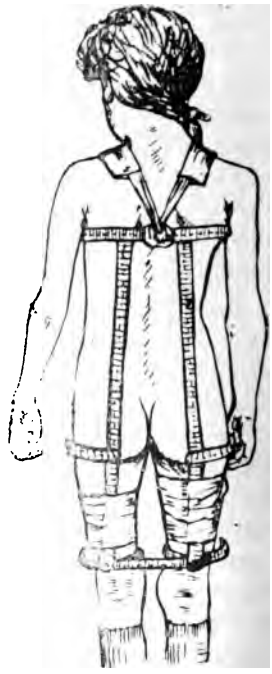

FIG. 45.

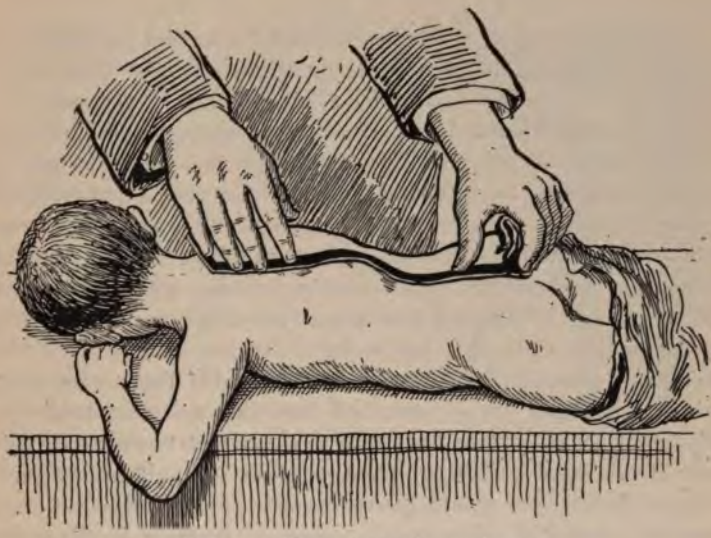

FIG. 45.—Measuring with metal tape.

iron, made somewhat longer and slightly wider than the patient, over which are snugly stretched two pieces of strong canvas, one reaching from the buttocks to the top of the frame and the other from just below the buttocks to the bottom of the frame; the space between the two being left for the use of the bed pan. Upon this stretcher the patient is placed, strapped down at the shoulders and hips, and traction is made from a head-sling upwards to a flange at the top of the frame, by means of an elastic or inelastic strap, and downwards by elastic or inelastic straps, attached to strips of adhesive plaster applied to the patient's legs, to two flanges at the bottom of the frame. The patient thus lying on the frame can rest upon the bed or be carried about without discomfort or motion in the spine.

The iron work of the frame can readily be done by any blacksmith, and the covering by the family of the patient; it should thus cost but very little. The surgeons of the Children's Hospital, in Boston reduce the expense still further by making the frame of iron gas-piping, and obtain traction from head and legs by the ordinary weight and pulley to the head and the foot of the bed.

The question as to the value of traction in the treatment of joint diseases should receive its solution from the results obtained by its use in spondylitis. The joints of the spine are most favorably disposed to show whether the results of traction are beneficial or not, and it is found: that a light weight is equally effective as a heavy one, and far more comfortably borne; that, in certain early and rapidly destructive cases, traction is undoubtedly a valuable aid in rapidly reducing the deformity, in rendering more efficacious the other means for immobilization, and in keeping the patient recumbent. But there is no evidence to show that any weight, that can be tolerated, will materially separate the bones in health, and if there were such evidence it would not necessarily follow that vertebræ held rigidly together by intense muscular spasm could be so separated; even if this were certain, or even probable, it would not be conclusive that its use would prove curative, or desirable, or even positively harmful. The whole theory of traction in the treatment of joint diseases must be remoulded, for it is founded upon the false assumption that "motion without friction" is a mechanical possibility. The premises of this theory have long since been abandoned, but the conclusions drawn from them are still cherished as a sacred inheritance.

The Poro-Plastic Felt Jacket.—The poro-plastic felt jacket is used by many surgeons in the place of the Sayre support. It receives public favor in that it is light, readily applied, and cleanly. The patient must be suspended ere it can be properly fitted, and the plastic qualities of the felt are exhibited by the use of hot steam. The felt is then moulded over a skin fitting vest, and the edges brought well together, the felt being well pressed to fit into hollows and over prominences. A few minutes only are needed to allow it to dry, and the patient derives its immediate support. After it has been worn a week any alteration it needs may be attended to, supporting steels affixed, and arrangements added to permit of lacing in the front. In a growing child it should be remodeled every six or eight weeks (fig. 47).

This is one the of worst forms of support procurable unless the kyphos is in the lower dorsal vertebræ. Even then it has but little to recommend it. It has no arrangement for relieving

the carious bone of superincumbent weight. It has no shoulder attachment, nor has it groin straps. Unless the jury mast is applied it has no supporting action above the axillæ, nor has it below the crests of the ilii. It must in consequence act only as a ferule, which, if too tightly applied, interferes with the play of muscle and ribs, and if too lax has no power to support. The sooner surgeons grasp the principle that efficient spinal support is not attainable without the aid of shoulder straps or their equivalents, the better it will be for those who suffer from spondylitis. The accompanying diagram is taken from a photo of a felt jacket removed from a patient. The position of the kyphos is easily seen, and the reader will note that the felt hardly extends above it. This is equivalent to treating fracture of the surgical neck of the humerus by splints confined to the lower fragments. One is not astonished, therefore, that failure so frequently accompanies the efforts at preventing deformity when fundamental, if simple mechanical principles are ignored.

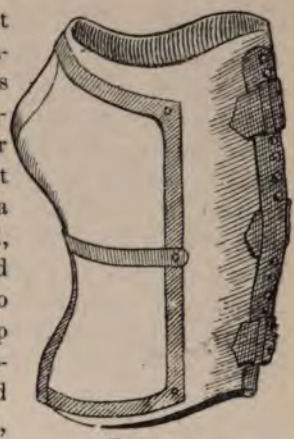

FIG. 47.

Operative Measures.—The operative measures in Pott's disease include aspiration with or without antiseptic injections, simple incision and drainage, or incision followed by scooping, with flushing of hot water, the wound being closed by suture, and no drainage provided for. Other operations attack the spinal column, either for caries or necrosis, or laminectomy may be performed for the relief of pressure paralysis. Simple aspiration, often repeated, has, as one might be led to expect, not proved of great value. It rarely succeeds in completely withdrawing the abscess contents, in consequence of the caseous masses found in the pus, and is often followed by increased activity of pus formation. We sometimes see, however, a single aspiration succeed in obliterating an abscess, but more generally, even after repeated aspirations, it ultimately proves a failure. We often notice after aspiration a disappearance, sometimes lasting for many weeks,

of all swelling, and then slowly the cavity refills. This points an obvious moral to those who publish cases as cured by incision, before allowing a sufficient time to elapse after operation to render a fresh collection next to impossible.

Aspiration, followed by antiseptic injections, has been advocated by several surgeons. Billroth by this means cured eighteen out of twenty cases. Mayo Robson reports favorably upon nine cases, treated by the injection of small quantities of iodoform and ether, and Willard, of Philadelphia, recommends the injection of iodoform emulsion after a small incision. In the author's hands these antiseptic distensions have not been more successful than simple aspirations.

Incision, for the relief of abscess may be made in cervical disease, behind the sterno-mastoid muscle; in dorsal disease, by the side of the vertebræ; in lumbar disease, just outside the erector spinæ; and in the case of psoas abscess resulting from disease in any part of the spinal column, above or below Poupart's liga-

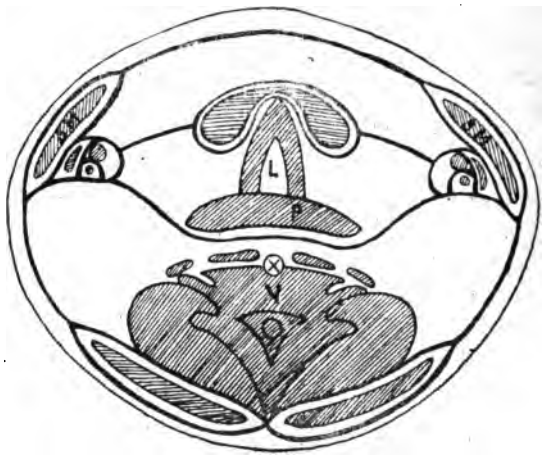

FIG. 48—Diagrammatic section through middle of neck, showing the attachment of pre-vertebral fascia (f) laterally to the carotid sheath, thus directing pus into the posterior triangle of the neck in cervical caries. The fascia is attached above to the base of the skull, below it becomes lost in the posterior mediastinum centrally, and passing over the brachial plexus at the root of the neck in front of the subclavian artery to be attached to the costocoracoid membrane. If the pus descends, it may find its way into the axilla or posterior mediastinum in addition to pointing in the pharynx and the posterior triangle of the neck, as indicated by the arrows.

ment, or it may be attacked from the lumbar region. The accompanying diagram shows the arrangement of the pre-vertebral fascial in the neck, and explains its attachments which have everything to do with the direction pus takes in the cervical region. The incision for the relief of abscess in this neighborhood should be made at the posterior border of sterno-mastoid, care being taken to avoid division of the spinal accessory nerve (which leaves the sterno-mastoid at its middle). The structures are then drawn forward with a broad retractor, when the transverse processes of the vertebræ will be easily felt. If the abscess is large, it will be seen bulging and can be easily opened (preferably by Hilton's method). The finger is then introduced and diseased bone felt for and if loose or easily detachable, removed by the finger nail or Volkmann's spoon. This operation should be performed however advanced a retro-pharyngeal abscess may be. It is a mistake to incise through the pharynx, as this situation can neither be drained nor kept aseptic.

Dorsal abscesses should be opened where they present. In the lumbar region, the vertebræ can be very easily reached by an incision along the outer border of the erector spinæ, cutting through the posterior lamella of transversalis origin (fig. 49). The middle sheet of origin is now divided and the quadratus lumborum exposed. This muscle is easily known by the direction of its fibres which pass upwards and inwards. The lumbar arteries give no trouble, as a rule, if the incision is kept as near to the middle line as the transverse processes of the vertebræ permit. By careful division the arteries may be seen if present, and they can be clamped before division. The anterior fasciæ of the transversalis origin is now seen and divided, and the finger passed along the front of the transverse processes and toward the bodies. The abscess in the psoas sheath can be easily felt by the finger, and fluctuation made out by pressing on the abscess in the thigh or abdomen from the front. The abscess should be opened, the vertebræ explored for sequestra, and the cavity wiped out and scraped gently with the finger nail or finger covered with perchloride gauze, the ends of which are held in the palm by the other fingers, when a slight general oozing of blood takes place, which soon stops. The cavity should next be washed out with hot antiseptic solution, preferably boracic acid.

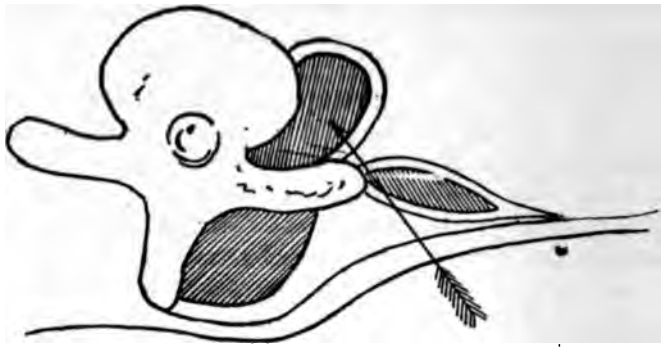

FIG. 49.

It will be found that the chronic abscess wall, after scraping, collapses much more readily. The edges of the incision may then either be stitched or not, the best way being by the use of a curved haghedorn needle in a holder. Deep sutures should be used for the quadratus and erector spinæ and the superficial wound should then be closed. If this has been done carefully and thoroughly aseptically the whole cavity becomes obliterated by organization of blood clot, which may fill the original abscess cavity now much collapsed. Before stitching has commenced, firm pressure is applied by an assistant pressing forcibly with both fists, one in the groin, the other over the abdominal wall, opposite to the psoas sheath. This pressure must be continued until a firm pad is placed where each fist pressed tightly. The pads are there fastened by a carefully applied spica, completed by a circular bandage over the abdominal wall. The loin operation was first described by Treves.

A. E. Barker has reported cases where he has successfully incised and flushed psoas abscesses. He takes a case where he presumes the bone lesion to be stationary or healing, but where a purulent collection is gathering. He makes a two-inch incision through sound structures in the most dependent part of the swelling, a hollow gouge is then inserted through the opening and connected by piping with a reservoir of hot water at 105° to 116°. The reservoir (a three-gallon can) is raised up to five feet above the operating table. The fundus of the abscess cavity is by this means flushed, and the contents are washed away. The

more solid caseous mass is dislodged by gently scraping with a scoop, until the soft lining membrane of the abscess is washed away. When the water runs out clear, the instrument is withdrawn, and all the water squeezed out. Iodoform emulsion is then injected into the cavity, and stitches applied through the skin, the surplus iodoform being squeezed out before the stitches are knotted; the cavity is then closed without drainage.

Laminectomy for the relief of pressure paralysis has been advocated by Macewen, Horsley, Lane, Willard, White, and others. The patient lies in a prone position, and a pillow is placed under the lower ribs to produce a curve in the vertebral column, and an incision is made over the prominent spines long enough to admit of the free exposure of their laminæ by retractors when the muscles are cleaned from them. Transverse notches in the muscles will facilitate this, and do no permanent injury because of the anchylosis of vertebræ; owing to the curve in the spine the muscles are often easily drawn aside. The laminæ are then carefully sawn with a spinal saw, or cut by bone forceps specially made for the purpose. The dura mater and cord are drawn to one side, and the tubercular material at the back of the body gently scraped away.

The results of this operation are not such as to encourage us in its employment in any but the most exceptional cases. It has distinct dangers of its own in its immediate effect upon the patient, and deprives the spinal column of practically its only support where the bodies are largely eaten away by disease. It certainly should never be employed where thorough and prolonged mechanical treatment has not been tried. It is extremely rare to find Pott's paraplegia permanent, and out of an experience which has been exceptionally large we can only recall two or three such cases, although we have experience of many instances where the paralysis has lasted considerably over a year.

It will be gathered from the foregoing that we favor an expectant, rather than an operative treatment, of abscesses in Pott's disease. This preference is based upon an experience of the large number of abscesses which have ultimately become absorbed; of the number which become extra articular in joint diseases; of the difficulty in keeping the cavity aseptic for an indefinite period; of the non-infective character of the abscess con-

tents before exposure; and of the difficulty in rendering an operation complete where we often cannot reach the offending vertebral bodies. The lining membrane of the abscess cavity with its envelope of fibrous tissue is an admirable protection againt general infection, and if this be allowed slowly to invade the surface, there is not a great risk of hectic and its accompaniments. That this serious condition does, however, sometimes follow a spontaneous opening we cannot deny, but we are convinced of its rarity. Of sixty-five cases of abscess, recently under the care of one of the authors, sixteen disappeared spontaneously, and ten are diminishing in size. Twelve were incised by quite a small opening when on the point of spontaneous evacuation, as evidenced by reddening of the skin, and three evacuated their contents without any surgical aid, while others remained stationary. In only three cases were there anxious temperatures, and in two of them recovery took place. In the case of the little patient who died, there were abscesses in both groins, and in the lumbar and dorsal regions, the cause of death being exhaustion. The marked feature of this case was the unusually persistent pain, which for months was most acute. Sufficient time has not yet elapsed to learn the ultimate results, and yet out of fifteen cases, where the openings were practically spontaneous, two closed in the first ten days, four more during the next three months, and three during the first year. Six are discharging at the present time, the discharge having lasted between two and three years. Many cases of much older standing, not included in this more recent list, and brought with discharging sinuses from long distances, bearing the fatigue of railway traveling with marvelously little discomfort. It will be readily seen, therefore, that unless the natural course of these abscesses be patiently studied one may be deceived by the published results of interferences. Of those operated upon, how many, for instance, might have recovered spontaneously? how many abscesses were merely residual in character? and how many of the deaths which followed operative procedure may be justly ascribed to the general dissemination of tubercular elements?

SACRO-ILIAC DISEASE.

Disease in the sacro-iliac articulation is of rare occurence. It is found generally between the ages of seventeen and thirty; existing apart from spondylitis in the lower lumbar spine it is of still rarer occurrence, and the diagnosis is so obscure that surgeons, careful observers with extensive experience in joint diseases, affirm that they have never met with it.

For the most part, and perhaps always, the disease is tubercular and is governed by the same laws of pathology, symptomatology, prognosis, and treatment that govern articular tuberculosis elsewhere. To spondylitis, however, the relation is especially close, and as has already been stated, it occurs much more frequently associated with lumbar spondylitis than as a seperate and distinct articular affection.

Traumatism appears to be frequently the exciting cause; but there can be no question that the disease occurs without any remembered injury, especially in those predisposed by heredity to tubercular infection. It may commence in either of the bones which go to form the joint, or in their neighborhood. Disease of the bones is far more frequently met with than that of other structures, and on account of the strength and thickness of the posterior ligaments, and the absence of definite subjective symptoms in an early case it is rarely recognized before suppuration has occurred or the bone has been considerably invaded. The disease may be of the so-called moist form and show early suppuration; or of the dry form and run its course without suppuration; or the dry form under certain circumstances may at any time become suppurative.

Van Hook, who has made the most recent careful study of the literature of the subject, believes that the dry non-suppurating form rarely imperils life and that the prognosis is in every way good, but that in the suppurative form the prognosis is exceptionally bad. It appears to us, however, that the symptoms detailed of many of the non-suppurative cases hardly warrant

the diagnosis of sacro-iliac tuberculosis, and by that much detract from the weight which they would otherwise give to a favorable prognosis; and that the fatal termination and consequently unfavorable prognosis of the suppurative cases have more frequently been due to the character of the operative interference than to the nature of the affection. There seems to us to be no good reason for believing that tuberculosis of the sacro-iliac articulation is governed in its fatalities by other laws than those governing the fatalities in tuberculosis of other joints, whilst our limited clinical experience of the disease goes to confirm this view. As in spondylitis, deaths occur from tubercular infection of other organs quite as frequently in the dry as in the moist form of disease, provided there be no operative interference. Death from prolonged suppuration is exceedingly rare when tubercular abscesses are subjected to the let-alone treatment, and rarer still is death from septic infection. On the other hand there can be no reasonable doubt that any operative interference increases the risk of general tubercular infection; and, unless the operation be strictly aseptic, and the prolonged subsequent dressings be kept so, the risk from septic infection of a large cavity connected with carious bone is considerable. In a word, any operation, which fails to remove all tuberculous material and to close the cavity by primary union without drainage, though demanded as a last resort, should be recognized as distinctly adding to the risks of the patient's life.

The records of the cases observed, show that fatal termination is usually due to septicæmia, simultaneous or intercurrent tuberculosis elsewhere, or general miliary tuberculosis.

Symptoms.—The first symptom to appear is usually a peculiar attitude, a "listing" of the trunk towards the unaffected side, or, more properly speaking, a shifting of the pelvis towards the unaffected side, and as this progresses, the spine assumes a long sweeping curve with its convexity to the sound side. Before the peculiar attitude has become sufficiently marked to cause comment, the patient has usually found himself fatigued from comparatively slight exertion, and has experienced difficulty in bending forward and rising up again. Ultimately stooping becomes quite impossible. The gait becomes of a waddling character, and as the disease advances the patient usually be-

comes unable to walk at all. In the early stage there is generally no flexion of the thigh and apparent lengthening may or may not be present, while apparent shortening is sometimes observed. The patient on standing rests well upon the heel of the affected side, but places nearly all his weight upon the sound leg. The distant or referred pain, characteristic of tubercular arthritis elsewhere, is usually present here, but may be absent, and is more frequently characteristic of this affection than of disease in the hip or spine. If present it is usually felt in the lower abdomen, but may be complained of anywhere along the front of the thigh and also along the area of distribution of the sciatic nerves. At first the swelling of the joint structures is often more easily made out by palpation per rectum, probably owing to the anterior sacro-iliac ligament offering much less resistance than the powerful thick posterior ligament, and early swelling therefore is directed towards the interior of the pelvis. Sooner or later, however, the external swelling appears, and in most cases advances to true fluctuation, and the tubercular abcess is present as a complication. These abcesses may and generally do extend in every possible direction: upwards in the multifidus spinæ into the lumbar region, downwards along the psoas muscle, or into the buttock, to the right or to the left, or directly inwards to open into the bowel.

The direction in which the pus travels may be:—

(1) Through the anterior ligament, keeping outside the pelvic fascia; (*a*) following the course of the sacral nerves and pyriformis out through the great sacro-sciatic foramen and forming an abcess under the gluteus maximus; (*b*) following the curve of the sacrum behind the rectum to the point in the ischio-rectal fossa, causing inflammation and adhesion of the rectum and ultimately bursting into it; (*c*) coursing under the lumbo-sacral ligament into the psoas muscle and thence into the thigh; (*d*) or into the iliacus muscle and thence into the groin.

(2) Through the back part of the joint into the multifidus spinæ, creeping along it and pointing in the lumbar region or directly over the joint itself.

Muscular atrophy of the buttock and thigh muscles is uniformly present. Deep pressure over the articulation often causes pain before much, if any, swelling is noticeable, and pressing

together or pulling apart of the pelvic bones also usually produces pain. This pain appears to be due more to the motion imparted than to the direct pressure exerted. At times there is a tilting of the bones one upon the other, and the joint forms a horizontal kyphosis or a deep depression. Spasmodic contrac-

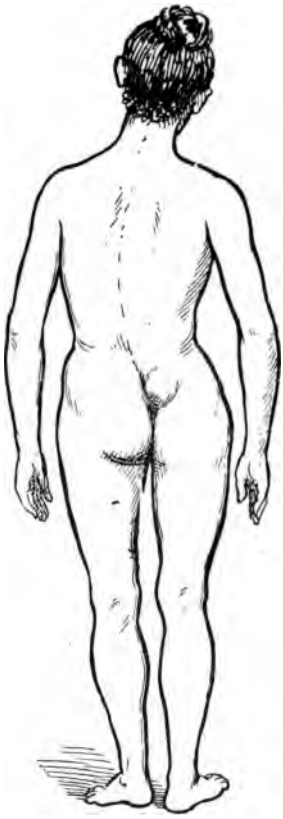

FIG. 50.—Sacro-iliac disease (abduction).

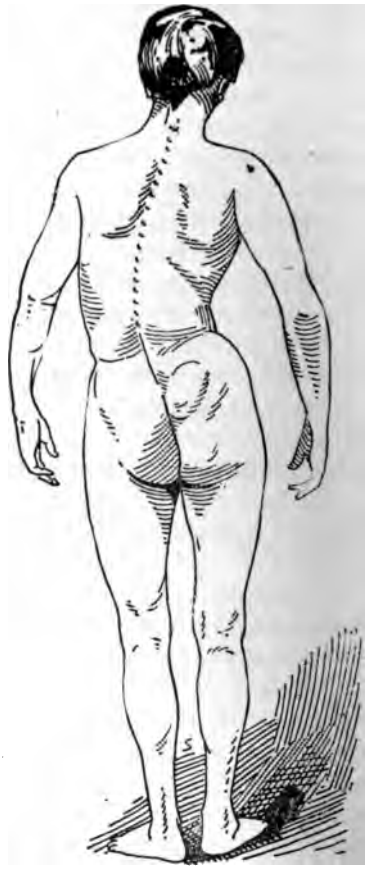

FIG. 51.—Sacro-iliac disease (adduction).

tion of the psoas muscle is a pretty constant and early symptom; resulting from this the thigh becomes somewhat flexed on the pelvis and rotated outward; hence frequent confusion with hip disease. All of the motions at the hip may appear

to be restricted, but, if the pelvis be steadied and the manipulations conducted with such gentleness as to not disturb the sacro-iliac joint, it will be found that, when the thigh is slightly flexed to relax the tension upon the psoas, all the hip-joint motions are normal except those which put the psoas on the stretch, namely, extension and inward rotation. In the same way the contracted psoas muscle limits the motions of the lumbar spine, and the resulting condition simulates lumbar spondylitis.

FIG. 52.—Abscess in sacro-iliac disease.

Passive bending of the spine towards the affected articulation or forward when the patient is recumbent, if done with great

gentleness and with the pelvis steadied, will by the freedom of movement exclude spondylitis from the diagnosis. The differential diagnosis is chiefly to be made from hip disease and spondylitis, and it can only be made by remembering that disease in any joint restricts not some but all its normal movements to some extent. In cases of sacro-iliac disease where the muscular spasm and pain are intense, it may not be possible at once to differentiate, especially since the disease has been seen coincident with hip disease and since it is more frequently found in conection with spondylitis than existing alone. The condition may be mistaken for sciatica or for intra-pelvic inflammation, or abscess in connection with old or recent perityphlitis, but a careful examination and a consideration of the history of the case should clear up these points.

Mechanical Treatment.—The mechanical treatment of sacro-iliac disease is not one of the most encouraging of orthopedic problems. It consists in a more or less successful attempt at immobilization, but it is found far less easy to immobilize this joint than the hip or spine, and satisfactory immobilization by an ambulatory apparatus is practically out of the question. The ambulatory apparatuses, which have seemed the most successful, have aimed at the accomplishment of two things: immobilization by circumferential compression by a broad girdle; and limitation to voluntary motion by a spinal apparatus which restricts forward bending. There is no question that motion in the lumbar spine is contra-indicated, and there should also be no question that motion at the hip-joint is contra-indicated, but restriction of the latter has not been attempted by ambulatory apparatus, since it would prevent the patient's sitting. The fact that the girdle, in a certain number of cases, relieves pain, which is not relieved, but too often aggravated by traction, points very suggestively in the direction of the true and false principles of the treatment of joint disease—namely, that a force which tends to immobilize, even when associated with a force which crowds together the articular surfaces, relieves pain where a force which tends to separate the joint surfaces without immobilization fails to relieve, and often increases the suffering. The mechanical treatment, then, which should be employed, is the Thomas double hip splint, with the main stems separate at such a distance that

they will pass to the outer side of the posterior superior spines of the ilia, with a broad leather sling passing from one stem to the other and reaching from the coccyx to the mid-lumbar region. Lateral wings should be attached to the stems to pass around the flanks on either side, and the pelvis is to be encircled by a

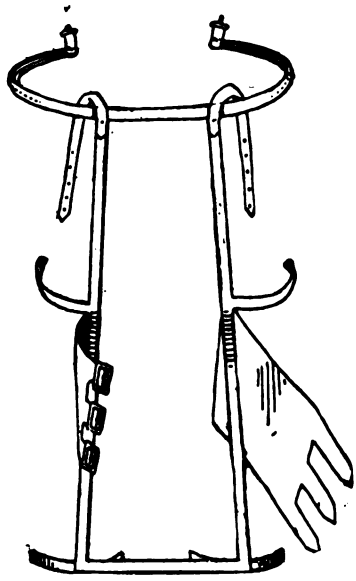

FIG. 53.—Apparatus for treatment of sacro-iliac disease.

FIG. 54.—Patient in apparatus.

broad girdle of leather or webbing. The apparatus in severe cases will extend below the knee; in others it may reach only to the lower part of thigh (fig. 54). The patient is to be kept continuously recumbent until the active stage of the disease has subsided for some time. Inasmuch as this disease appears in adult life, and but rarely in children, and inasmuch as the

joint is readily accessible, we are of the opinion that as soon as suppuration occurs, operative measures looking to the removal of all tubercular matter are to be considered, and that such measures are justifiable in a larger percentage of cases than when disease attacks any of the other joints. It is of advantage to prevent, when possible, intra-pelvic burrowing, and this can be done without our having to reflect (as we are forced to in the case of hip or knee) upon an anchylosis which is here harmless, or a shortening of the limb, which of course cannot occur.

The *Operative Procedures* are determined by the facts learned from palpation externally and by the rectum. If an abscess can be detected within the pelvis, the incision is made directly down upon the ilium external to this point, the bone trephined, the abscess cavity gently and thoroughly cleansed, more bone removed if necessary with cutting forceps or chisel, all cut bone surface thoroughly seared with the actual cautery and the wound closed. If no point of fluctuation can be made out, the incision is determined by the œdema; or, in the absence of the œdema, by the tender point. The bone is trephined for a caseating centre, and the subsequent steps of the operation are as above indicated. After any operative procedure, the joint should be immobilized in the Thomas double-hip splint, and the patient confined to bed until all local tenderness has passed away.

It is possible that there are more reasons to justify the use of the drainage tube after operations upon this joint than upon others, but we believe that a second or more repetitions of the operation entail less risk than its insertion.

HIP-DISEASE.

THE term hip disease is used for any chronic inflammation in the synovial membrane of the hip-joint, in the acetabulum, in the head, neck, or the great trochanter of the femur, or in soft parts immediately surrounding these, which, if allowed to progress without treatment, would ultimately present the symptoms of a tubercular arthritis. From a clinical standpoint—the standpoint from which these articles are written— it does not appear

FIG. 55.—Severe coxitis in boy, six years. (*a*) Cheesy spot in head of bone; it has infected the surrounding medulla (*bb*) and extended to shaft. (*d*) Compession groove on head of femur produced by rim of acetabulum (after Krause).

possible to the authors to accurately diagnose the situation of the primary lesion in more than a few cases; nor is it possible to differentiate between a small tubercular focus in the acetabulum and one in the head or neck of the femur and often it is not possible, for some time, to differentiate between a condition

which will ultimately result in the separation of the head of the femur, and one which will end in the separation of the great trochanter. Further, we are not able to point out the difference between tuberculosis immediately within the capsule and the same state of affairs immediately without that membrane. From a clinical standpoint we can only approximately locate a lesion which, unrestricted, ultimately involves all or nearly all of the neighboring tissues; which under treatment usually recovers, leaving us still in doubt as to its precise habitat, and which wherever be its origin demands one and the same treatment. This, then, in a routine way, we characterise by the general term, hip disease.

FIG. 56.—Resected upper end of femur of a girl aged five years. Large cone-shaped subchondral focus with demarcation far advanced. Articular cartilage lifted up like a vesicle (after Krause).

Tuberculosis at the hip-joint usually commences as a primary or secondary osteitis, more frequently in the femur than in the acetabulum (figs. 55 and 56). It may undoubtedly commence as a primary tubercular synovitis, but many cases of synovitis follow from a traumatic rather than from a tubercular origin. Peri-arthritic inflammation seems to derive its origin more frequently from the infectious fevers than from other causes. The favorite habitat of these lesions in the children of syphilitics is in the neighborhood of the epiphysial line.

However the joint disease may commence, it is at the beginning, or very soon becomes tubercular. In the same way, wherever the lesion may be primarily found, if left untreated it goes progessively on, extending from one tissue to another until all the structures of the joint become involved, and the result is a tubercular arthritis. It is, then, with a tubercular arthritis,

more or less complete, that we have to deal in discussing the symptoms, prognosis, and treatment of hip disease.

Symptoms.—Almost invariably the first symptom noticed is a slight limp. This usually begins before there has been any complaint of pain, and it remains until a cure has been effected, and not infrequently it persists to the very end of life. In a few cases there may be one or more intrevals of intermission during the early months of the disease. The limp is due to the inability of the patient to fully extend the thigh on the pelvis more than to any sensitiveness of the joint to weight-bearing; although, in untreated cases, and in very many that are sub-

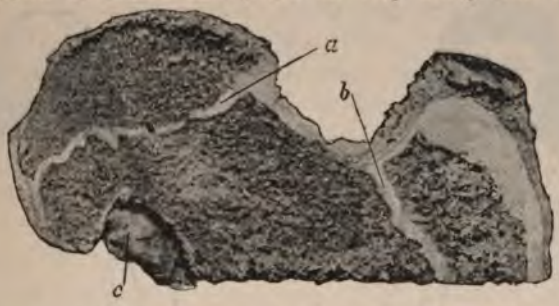

FIG. 57.—(*a*) Epiphysial cartilage of the head. (*b*) Cartilage of trochanter major. Partially destroyed head covered by a layer of granulation tissue. (*c*) At lower end of neck a cheesy sequestrum which has infected the joint (after Krause).

jected to treatment, there comes a time when walking is difficult or impossible from the sensitiveness of the joint and its inability to sustain the weight of the body. Nevertheless the characteristic limp of hip disease is not one of pain; it is rather one of impaired function.

As a rule the patient very early in the disease becomes restless in sleep, and may cry out without fully awaking. The cry is peculiar, and consists in a sudden, sharp, frightened scream, occurring during the first hours of sleep. These night cries commonly precede and almost invariably accompany a period of pain. They have been considered as characteristic of osteitis, though there can be no doubt of the presence of osteitis in certain cases where no night cries are heard; it is more probable that they are indicative of a rather rapid development of a tubercular abscess under tension. The symptom is valuable, in

the early stage of the disease, only as a corroborative of other symptoms, and as a hint to the prognosis of abscess.

Pain is usually complained of at some time during the course of hip disease, but the fact must not be lost sight of that it is rarely complained of until long after limping has appeared. It disappears months, and often years before the joint is cured, and patients with non-suppurative, and at times with suppurative hip disease may never feel the least pain from the commencement of the limping all through the three or four years' course of the disease to a cure, resulting perhaps in a perfectly anchy-

FIG. 58.—Flexion of femur on pelvis with no accompanying abduction or adduction.

FIG. 59.—Showing obliteration of buttock fold and abduction.

losed joint. When pain is present it is usually complained of at the inner side of the anterior surface of the knee, but it may be felt at any part of the hip or thigh; like the night cries it is a corroborative rather than a diagnostic symptom. It is indicative of an osseous lesion, and, coming on or growing worse without assignable cause during the course of treatment, should be considered as pointing to the development of abscess.

Inspection of a case of disease, stripped for examination, reveals flexion of the thigh upon the pelvis with or without accompanying abduction or adduction. Most cases present one or the other lateral deformity, but the rule is not invariable, and some cases run their course and go on to a great degree of flexion without either abduction or adduction (fig. 58).

Abduction when present usually accompanies the early stage of the disease, and has been looked upon as indicative of effusion within the joint, but of this we do not feel certain. We have observed it late in the disease, and in cases where we have never been able to make out fluctuation. This position of abduction gives a false lengthening to the limb, and is the cause of the obliteration of the buttock fold (figs. 59 and 60).

Outward rotation or eversion of the limb is usually associated with abduction, and inward rotation with adduction. The cause of these malpositions has not been absolutely determined; but it would seem probable that the position of the tubercular focus together with the assumed attitude of the patient determines the malposition. The patient assumes the attitude of greatest comfort whether lying, sitting, or standing, and this strongly influences the deformity in the early stages of the affection. Later the malposition is determined by the unbalanced force existing between the opposing groups of muscles in their effort to immobilize the joint, or between the muscular groups on the one hand, and the mechanical device employed in the treatment of the disease on the other hand.

Muscular shrinking, generally believed to be due to reflex influence, comes on early, is very constant, and may be regarded as a valuable symptom. It has been claimed by careful observers that this muscular atrophy is due solely to disuse, inasmuch as it bears no constant relation to any other factor involved; but we have observed a case in which the limp had been present for

only two weeks, and in which there had been no pain and no cessation from usual avocation, and yet in which there was found a circumferential measurement one inch less than in the opposite thigh, a difference which went on increasing at a less, but at an unusually rapid rate during the succeeding fortnight before the application of apparatus. The fact that we did not know the relative sizes of the thighs before the limping commenced renders this case of no absolute value in controversial argument, but we are much inclined to believe that there is present in these cases a shrinking of the muscular masses over and above that due to disuse, or to the constricting effects of the dressings used. Muscular shrinking is so constant a symptom that it may be regarded as of very great diagnostic value.

FIG. 60. Flexion and abduction.

Shortening may be either actual or practical. Actual shortening is due either to arrested growth, to actual bone destruction, or to partial or complete subluxation. None of these conditions are found early in the disease, but an accurate record should be kept, for in this way the prognosis as to the ultimate length of the limb can best be judged. Practical, or false, shortening is due to adduction or flexion, or both. It is from the relation of the actual to the practical shortening that we conveniently compute the degree of adduction.

The extent of flexion caused by the deformity may be estimated in the following manner: Whilst the patient is on his back, on a table, the surgeon lifts the diseased limb until all lordosis is corrected, and the pelvis is in a normal position. He applies a tape measure along the outer border of the limb in a line with the femur, commencing at the point where it diverges from the table. He measures the length to any point, and the

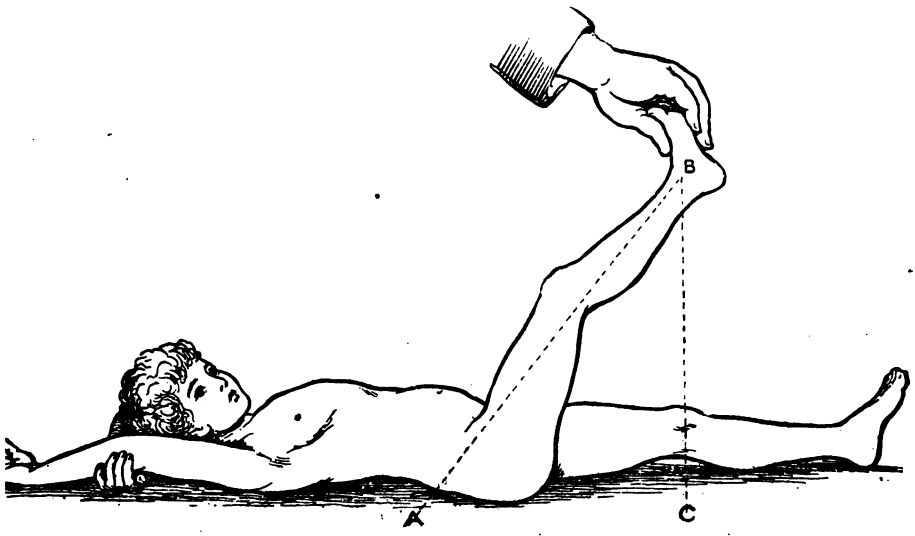

FIG. 61.—Method of measureing the angle of flexion.

length of a perpendicular from that point down to the table. The decimal fraction obtained by dividing the length of the perpendicular by the length measured along the limb will give what mathematicians call the sine of the angle. By consulting a book of mathematical tables the angle is found. G. L. Kingsley measures a constant length of twenty-four inches along the thigh, and then publishes a table showing the angle corresponding to the length of each perpendicular. For the convenience of readers we append Kingsley's tables. The diagram (fig. 61) explains the direction of the lines for the purpose of estimating the flexion angle.

IN.	DEG.	IN.	DEG.	IN.	DEG.	IN.	DEG.
0.5	1	6.5	16	12.5	31	18.5	50
1.0	2	7.0	17	13.0	33	19.0	52
1.5	3	7.5	19	13.5	34	19.5	54
2.0	4	8.0	20	14.0	36	20.0	56
2.5	6	8.5	21	14.5	37	20.5	58
3.0	7	9.0	22	15.0	39	21.0	60
3.5	9	9.5	24	15.5	40	21.5	63
4.0	10	10.0	25	16.0	42	22.0	67
4.5	11	10.5	27	16.5	43	22.5	70
5.0	12	11.0	28	17.0	45	23.0	75
5.5	14	11.5	29	17.5	47	23.5	80
6.0	15	12.0	30	18.0	48	24.0	90

To measure for abduction and adduction the method of R. W. Lovett, of Boston, is the readiest and best. The patient is made to lie straight with the legs parallel. The surgeon now measures for real and for false shortening. Real shortening is found by measuring from the anterior superior spine of the ilium to the inner malleolus on either side and comparing them. False or practical shortening is estimated by comparing the distance between the umbilicus and the inner malleolus on either side. The difference in inches between the real and false shortenings is noted. We then measure the distance between the anterior superior spines. Having obtained this information we turn to Lovett's table. If the line which represents the amount of difference in inches between the real and apparent shortening is followed until it intersects the line which represents the pelvic breadth, the angle of deformity will be found in degrees, where they meet. If the practical shortening is greater than the real shortening, the diseased leg is adducted; if less than real shortening, it is abducted. Take an example: length (from anterior superior spine) of right leg, 23; left leg, 22½; length (from umbilicus) of the right leg, 25, left leg, 23; real shortening, ½ an inch; apparent shortening, 2 inches; difference between real and practical shortening, 1½ inches; pelvic measurement, 7 inches. If we follow the line for 1½ inches until it intersects

LOVETT'S TABLE.

Difference in Inches between Real and Apparent Shortening.	Distance between Anterior Superior Spines in Inches.																
	3	3½	4	4½	5	5½	6	6½	7	7½	8	8½	9	9½	10	11	12	13
¼	5°	4°	4°	3°	3°	2°	2°	2°	2°	2°	2°	2°	2°	1°	1°	1°	1°	1°
½	10	8	7	6	5	5	4	4	4	4	4	4	4	3	3	3	3	2
¾	14	12	11	10	8	8	7	7	6	6	5	5	5	4	4	4	3	3
1	19	17	14	13	11	10	9	9	8	7	7	7	6	6	6	5	5	4
1¼	25	21	18	16	14	13	12	11	10	9	9	8	8	7	7	7	6	6
1½	30	25	22	19	17	15	14	13	12	12	11	10	10	9	9	8	7	7
1¾	36	30	26	23	20	18	17	15	14	13	13	12	11	10	10	9	8	8
2	42	35	30	26	23	21	19	18	16	15	14	14	13	12	12	10	10	9
2¼	..	40	34	30	26	24	21	20	19	17	16	15	14	14	13	12	11	10
2½	..	..	39	34	29	27	24	22	21	19	18	17	16	15	14	13	12	11
2¾	..	..	..	38	32	29	27	25	23	21	20	19	18	17	16	14	13	12
3	..	..	..	42	35	32	29	27	25	23	22	21	19	18	18	16	14	13
3¼	..	..	..	..	39	36	32	30	27	26	25	22	21	20	19	17	15	14
3½	..	..	..	..	..	40	35	33	30	28	26	24	23	22	21	19	17	16
3¾	..	..	..	..	..	..	38	35	32	30	28	26	25	23	22	20	18	17
4	..	..	..	..	..	..	42	38	35	32	30	28	26	25	23	21	19	18

the line for pelvic breadth of 7 inches, we find 12° to be the angle of deformity. As the practical shortening is greater than the real, it is 12° of adduction of the left leg.

Actual lengthening of the diseased member rarely occurs, but we have observed it during the course of treatment by the long traction hip-splint. The importance of an accurate record of the angle of flexion and adduction, or abduction, is of the greatest importance. Upon it, and upon it alone at times depends the diagnosis of the disease; and upon it depends the diagnosis of a cure in all cases resulting in anchylosis. A joint in which the angle of deformity is changing is capable under proper treatment of gaining a still greater degree of usefulness. In a case destined to result in anchylosis a cure is not effected until the angle of deformity ceases to change.

The involuntary muscular spasm, which restricts the motion of the joint or absolutely limits it, is the diagnostic symptom of joint disease. It is the first symptom to appear and the last to disappear, and it is the only symptom upon which dependence can always be placed in making the diagnosis. It is believed to be of reflex character and to be due to the irritation of the nerves which supply the joint. It affects only the muscles which control the movements of the diseased joints, but it affects all of them. Upon this depends the diagnosis of the disease and the differential diagnosis from affections which closely simulate the disease. Lack of normal extention and rotation is usually more noticeable in the first weeks of the disease than are restrictions to flexion and to latteral momements; but a careful comparison between the movements possible at the two hip joints will make the defect apparent to one who has become at all familiar with this peculiar symptom. To describe the nature of the spasm is scarcely possible; it is one of those things better learned by touch than by description. In attempting any of the normal passive motions at the joint it will be found that in most cases motion is quite free to a certain point; it is there checked, not with the slow elastic resistance of voluntary muscular opposition, nor with the sudden dead stop of ligamentous or fibrous adhesions, but suddenly and positively. Once felt, it is always to be recognized.

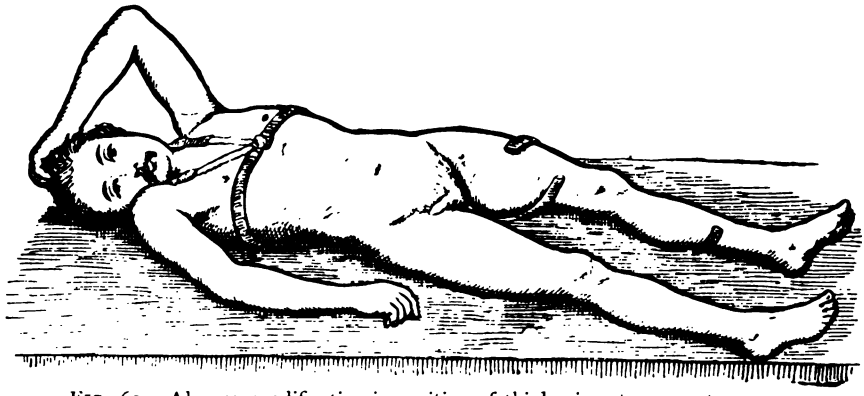

FIG. 62.—Abscess; modification in position of thigh wings to prevent pressure.

Abscesses occur in about half of all the cases where treatment is not commenced very early. They may be present in any relation to the joint, but the most frequent position for the first abscess to appear is somewhat below and to the inner side of the anterior superior spine of the ilium. The abscess may appear early in the disease or at any time during its course. It is usually ushered in by a period of pain, night cries, and increase of deformity; flexion is always present, and abduction is frequently found in early abscesses while adduction is more frequently met with later in the disease. During the treatment of the disease any exacerbation of pain or tendency to deformity, unless there has been some well-recognized traumatism, is suggestive of the formation of abscess and warrants that prognosis. The first objective sign is a brawny feeling in front of the joint; this is, or soon becomes, tender to pressure, ultimately softens in its center and fluctuation may be made out. The area of fluctuation extends, the extention usually being in the outward and downward direction, and at times fully two-thirds of the upper, outer, and anterior portion of the thigh is occupied by a fluctuating tumor (fig. 62). The abscess may, however, appear posteriorly to the great trochanter, or it may find its way through the acetabulum, and be made out within the iliac fossa, whence it rises up over the brim of the pelvis, following much the same course as a psoas abscess, and on reaching the thigh occupies its anterior and inner aspect. In some cases it simulates an anal

abscess, and after spontaneous opening the persistence of symptoms suggests a fistula-in-ano. Much care is required in differentiating it. The course of an abscess left untreated is to spontaneous opening and evacuation. If the abscess spontaneously opens or is opened early, the pus is thick, yellow, and creamy in character; later on the solid contents separate themselves from the fluid, and the abscess cavity is filled with a clear whey-like liquor, in which float large or small curds of coagulated fibrin. The abscess opening spontaneously at this time discharges at once the whey-like fiuid, and the fibrinous curds come away later according to the size of the opening. If, however, the joint be treated by rest, very many cases do not go on to spontaneous opening; the abscess passes through the stages already indicated of a creamy pus succeeded by a thin serous fluid floating flakes of fibrin, when the fluid is absorbed and the fibrinous masses remain. Frequently the sac containing these fibrinous curds will become cut off from the joint, and remain quiescent for months or even for years, then rapidly liquefy and empty itself, or the contents may be absorbed, undergoing what is believed to be a fatty degeneration.

Rarely, during the development of abscess, is there any especial fever or constitutional symptom except such as may be attributed to the pain; and the pain is felt only while the abscess is intra-capsular or is subperiosteal; when once the pus has escaped from the bone or joint, the suffering ceases and almost invariably the general health of the patient improves. The course of the sinuses, which remain after the spontaneous opening of the abscess of hip disease, is towards closure, at least when carious bone is no longer to be drained. A sinus leading to a cavity not connected with carious bone will usually close within a few weeks; one leading to carious bone will remain open until the bone is thrown off, or removed, or drained through some other channel. These spontaneous openings show a much greater tendency to closure than do the sinuses remaining after operative interference; especially is this true if the operative interference has been accompanied with the use of the rubber drainage-tube, the sinuses from which show very little tendency to closure. The course of these abscesses treated by aspiration depends entirely upon the nature of the contents and whether

or not they are connected with carious bone. The creamy abscess can generally be aspirated, but it is usually connected with carious bone, and almost invariably refills. The abscess containing the whey-like fluid and fibrinous curds can rarely be evacuated, even through a needle of trocar size, and these also usually refill when aspiration has been attempted. The course of abscess under treatment by incision also depends upon the nature of the abscess cavity; if all the tubercular material at the osseous focus can be removed, it may be expected that primary union will result, otherwise a sinus remains more subject to septic infection than the sinus resulting from a spontaneous opening.

FIG. 63.—Hip disease left side, patient unable when the pelvis is fixed to straighten the diseased limb.

FIG. 64.—Normal lordosis during recumbency.

FIG. 65.—Patient able to obliterate such lordosis at will without flexing thighs. This cannot be done in hip disease.

The diagnosis of hip disease is rendered comparatively easy by what is known as the Thomas flexion test. This is founded upon our inability to extend an inflamed hip without producing lordosis. By lifting the sound knee until it touches the chest the pelvis is fixed and the spine is straightened. If there be hip disease the patient is unable to extend the thigh on the diseased side and it remains at an angle (fig. 63). If disease is absent the leg can quite easily be made straight. Few surgeons seem to have observed that if we take any healthy subject and lay him flat upon a table or other hard plane we can easily pass our hand

under the lumbar vertebræ (fig. 64), but if we ask the subject to touch the table with his back he is able to obliterate the hollow without lifting his limbs (fig. 65). We have here therefore a very ready guide for the detection of deformity (fig. 69). In no case of hip disease is the patient able to straighten his spine, until art has stepped in and corrected the flexion deformity.

The application of the flexion test in the case of an infant requires considerable delicacy. A child of two or three years old is brought for examination. A vague history of irritability may be alone complained of, or pain may be occasioned while the child is washed. The surgeon is to find out in the first place whether there is an inflamed joint, and if so, on which side. The child is gently put upon the table while the surgeon without exciting alarm holds a knee in either hand. The thighs are slowly flexed towards the chest, when it is observed that one easily yields to full flexion while the other becomes a little rigid (fig. 66). The stiff hip is then gently allowed to fall while the sound one is fully flexed (fig. 67.) It will then be perceived that the diseased limb remains at an angle and cannot be fully extended. Stress must be laid upon the necessity of not startling the child and in not using the slightest force; while care must be

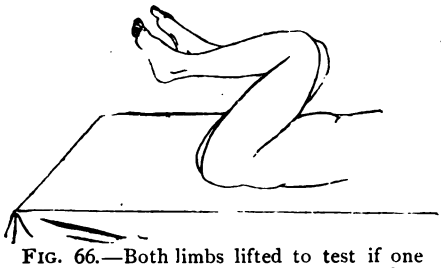

FIG. 66.—Both limbs lifted to test if one yields easier than the other. Care to be taken lest pelvis be lifted on spine.

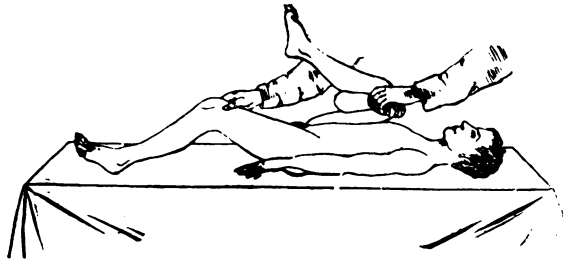

FIG. 67.—Surgeon gently flexes both limbs, and finding the left more rigid, continues only to flex the right, while he allows the left to fall. Useful in the case of small children who cannot say on which side disease is.

taken first, not to flex the pelvis upon the spine and secondly to conduct the examination upon an even flat surface.

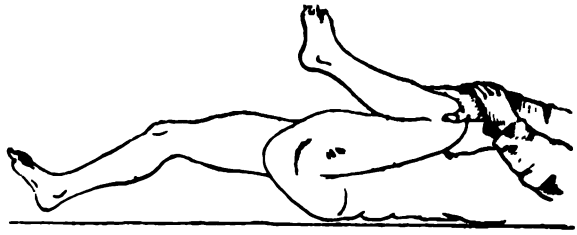

FIG. 68.—Faulty method of examining by lifting pelvis upon spine.

Although this test is not absolutely diagnostic, if the hip be complained of, and pelvic, vertebral, sacro-iliac and malignant disease be negatived, one can fairly infer the presence of coxitis.

FIG. 69.—Shows lordosis present in hip disease.

Differential Diagnosis.—Hip disease is perhaps more often confounded with Pott's disease of the lumbar spine than with any other one condition. In Pott's disease the only motions at the hip joint, which are restricted, are those in which the psoas muscle is put upon the stretch, namely, extension, and inward rotation while in the fullest possible extension.

Sacro-iliac disease restricts the motions at the hip joint in precisely the same way as does Pott's disease, flexion, and rotation during flexion, being perfectly free.

Treatment.—It is the function of a normal hip joint to permit of motion in several directions and to sustain the weight of the body, both during walking and while standing at rest, without injury to its structure. When a joint becomes diseased these functions become restricted or abolished, motion is no longer possible, or possible to only a limited degree, and the joint refuses to sustain the superincumbent weight for any prolonged period.

If we study the clinical evidences presenting at a hip joint, as it passes from health to disease and back to health again, we find them to be somewhat as follows: All the muscles, whose function it is to move the thigh on the pelvis, gradually become more and more rigid from involuntary muscular spasm until all motion at the joint is abolished. The thigh becomes gradually flexed on the pelvis, and usually at first abducted; later on as flexion increases it becomes adducted, but in either case the position is such that in walking the full weight is not thrown upon the diseased member for more than a brief time at each step, and prolonged weight bearing, while standing at rest, is not possible.

The joint becomes more and more sensitive to the vibration of locomotion, weight bearing is no longer tolerated, and the patient takes to his bed. The leg in any case assumes the position of greatest comfort and the muscular spasm protects the joint which by this means becomes locked. As the patient drops asleep the muscular spasm relaxes somewhat, and, if the limb does not lie securely fixed, motion takes place at the joint, injury is inflicted, the patient screams with pain, and the muscles are again on guard.

Long continued malposition results in structural shortening of the tissues on the side of the flexion and immobilization of the joint is maintained with but little muscular effort. When the joint has been freed from motion and weight bearing for a certain time the tenderness passes off, and the patient is able to move about his bed without suffering and ultimately arises and walks often bearing his whole weight upon the affected member without pain. Nevertheless muscular spasm and rigidity are maintained for a very considerable time. When the disease has terminated the spasm disappears, but the structural shortening of the soft parts remains, and yields gradually to use during the subsequent months and years; but, if the disease has been of a severe type, it always remains to some extent.

The result of this cure by the natural process is usually a limb flexed and adducted, with true or false shortening, and a joint which lacks the normal range of motion. These defects appear to be due to the prolonged course of the disease, which hinders the growth of the limb and renders more rigid the shortened

muscles; to the position of deformity in which the leg rests while structural shortening takes place, giving rise to permanent flexion and adduction and to their result, false shortening; and finally to the exaggerated bone erosion and consequent true shortening brought about by nature's unaided imperfect immobilization and protection.

The efforts of nature to effect a cure may he supplemented by art. The means which art adopts are: To protect from deformity, or, if it has already appeared, to correct it, and thus it robs the muscular contracture of its deforming power; to immobilize the joint, and thus relieve the muscles from a state of spasm and subsequent contracture; to relieve pain and prevent the bone destruction due to both attrition and pressure; to relieve the joint from weight-bearing, and the pressure arising therefrom; and finally, to diminish all these by shortening the course of the disease. The all essential element of treatment, beyond the correction of any existing deformity, may be summed up in one word—rest. The ideal treatment would be perfect rest of the joint from active and passive motion, from the jarring incident to all locomotion, and from intra-articular pressure due either to muscular spasm or to weight-bearing. Such an ideal treatment we do not think has ever been attained.

FIG. 70.—The Davis hip splint.

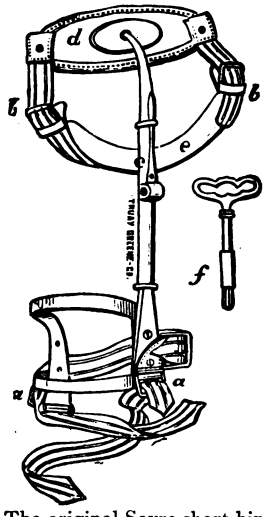

FIG. 71.—The original Sayre short hip spliut.

The fathers in surgery treated hip disease by rest in bed and by more or less successful attempts at immobilization. Decros, in the Gazette des Hospitaux of June 30, 1835, published a case of hip disease in which traction was employed. In 1839, J. H. James, of Exeter, England, presented at the Provincial Medical and Surgical Association, at Liverpool, a plan of immobilization for the treatment of fractures of the thigh, by the use of traction in the axis of the shaft of the femur. In the same year William Harris, of Philadelphia, published a series of four cases of hip disease in the Medical Examiner, January 19, treated by traction and counter-traction combined with Hagedorn's apparatus for fractured thigh. The first of these cases was four months after Decros' paper.

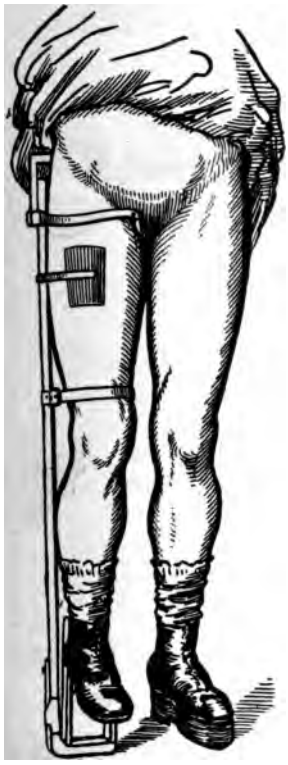

FIG. 72.—The Taylor hip splint.

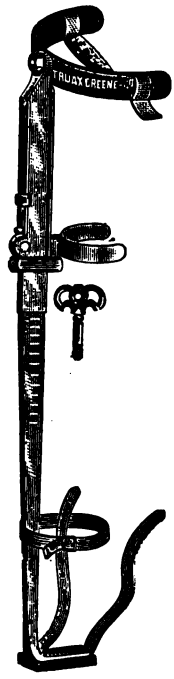

FIG. 73.—Judson's hip splint.

The first portable traction hip splint was devised by Ferdinand Martin and is illustrated in Bonnet's "Therapeutics of Articular Disease," Paris, 1853.

Following these, traction was used by various surgeons with weight and pulley and other devises, as a means of immobilization in the treatment of hip disease. In 1859, Henry G. Davis, then a resident of New York City, presented a plan of treatment essentially different in principle from any that had been previously employed. It consisted of a mechanical device, intended to give elastic traction and counter-traction at the hip joint, without restriction of the normal motions of that articulation, the attempt being to separate the articular surfaces and to thus obtain "motion without friction" at the joint (fig. 70). Another

FIG. 74.—The Sayre long hip splint.

FIG. 75.—Shaffer's hip splint.

radical change in principle was that the apparatus was to be employed while the patient walked, it being expected to furnish ample protection to the joint from the traumatism of locomotion. These principles of an ambulatory apparatus, which permitted motion at the joint and protected it by elastic traction and counter-traction, were at once adopted by Dr. Lewis A. Sayre, Dr. Charles Fayette Taylor, and others, and the treatment, which was believed to allow "motion without friction," became know as the American plan of treatment (fig. 71).

It is, perhaps, unnecessary to say that the principles upon which this treatment was based have been entirely abandonened by the profession. Traction obtained by a mechanical device, known as the long traction hip splint, is still used both during

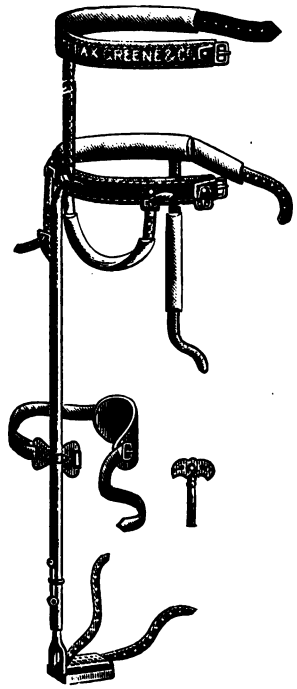

FIG. 76.—Ridlon's long traction hip splint, with fixation body piece. This splint is no longer made use of by the authors.

recumbency and during locomotion, but it is no longer used with the idea that "motion without friction" is a mechanical possi-

bility. Perhaps the best commentary upon the use of the long traction hip splint is found in the fact that in the city of New York three of the veterans in the profession use practically the same splint in the same way for the accomplishment of three different ends—namely, Dr. Judson uses the splint for the fixation is gives, Dr. Sayre uses it for the motion which it permits, while Dr. Shaffer believes the beneficial effect chiefly rests in the traction which it exercises.

We would not be understood as denying that inelastic uninterrupted traction is an effective, though by no means the most effective, means of obtaining fixation during recumbency; but traction applied by means of any apparatus upon which the patient walks, not only fails in immobilizing or in being a useful immobilizing adjunct to any other apparatus, but it actually increases motion, tremor, and irritation at the articulation. This was pointed out so long ago as 1879 by the late Joseph C. Hutchinson, of Brooklyn. It is only necessary to observe a child walking upon a long traction hip splint to recognize this fact.

The hip splint is applied whilst the patient is recumbent with a traction of eight or ten pounds. The weight of the splint is from four to six pounds. When the patient stands upon the healthy extremity and lifts the affected member and splint the traction upon the joint is from twelve to sixteen pounds. In taking the first step the splint is placed upon the ground and the sound limb lifted, when the whole weight of the patient, from fifty to one hundred and fifty pounds, is thrown upon the perineal supports. They yield somewhat, the splint bends a little and the traction force is entirely relaxed as shown by the straps bagging at the ankle ; with the next step, when the splint is raised from the ground, fifteen pounds of traction is again in force. We have thus an alternate traction of fifteen pounds and a relaxation which allows almost the full force of the muscular spasm to drive the bone upward in to the diseased socket. This push-and-pull or pumping action at the joint goes on with each step at the rate of at least three thousand strokes an hour as the child runs about in his ordinary play. It would appear then that the traction splint used during locomotion is an excellent means for increasing motion at the joint, and that there is no excuse for those surgeons who used this device as a means of

immobilization, or with the idea that it gives continuous traction. Traction may add to effective immobilization, and in convalescent cases may be used without serious harm, provided the patient uses crutches and has a patten on the foot of the sound side sufficiently high to effectually prevent the apparatus from coming in contact with the ground. We do not advocate this plan of treatment because we think that so long as it is agrued a patient can find any relief or benefit from the use of traction, he should be confined to the recumbent posture. When the joint has sufficiently recovered to warrant locomotion, traction is unnecessary. In the case of the hip it is especially so. Surgeons advocate it on the plea that it diminishes intra-articular pressure. In early coxitis it can only induce pressure upon the lower and inner aspect of the acetabulum and the corresponding portion of the femur. In the late stages it can only viciously pull upon the soft structures helping to form the joint. Apparatuses devised to give traction during locomotion are expensive, difficult of application, easily misplaced, require frequent attention, are harmful if used during the stage of pain and useless after it has passed.

We have used the long traction hip splint in many hundred cases of hip disease and we have abandoned its use because: it does not at best, readily overcome deformity; it permits the development of a marked degree of flexion with abduction, or adduction in cases where no deformity at first existed; because under it use patients suffer again from exacerbations of pain and increase of deformity, which always force them to bed for a longer or shorter period; because under its use the period of treatment is exceedingly long and because the results are far from perfect.

Nearly all cases when cured present the deformity of flexion and adduction and the false shortening arising therefrom; they present a great rigidity and considerable real shortening and not a few of them a functionless flail joint at the knee from the indefinitely prolonged pull. All that is necessary for the safe conduct of the joint may be obtained by the use of an apparatus simple of construction, slight of cost, easy of application, not readily misplaced, rarely requiring attention, more effective to overcome deformity, to prevent the development of deformity,

and to allay muscular spasm and pain than any traction apparatus with which we are familiar.

We do not describe any apparatus of the many in general demand except that which we ourselves have in constant use in all our cases. This apparatus is known to the profession as the Thomas hip splint (fig. 77), known so, deservedly, because it was first used by the late Hugh Owen Thomas, of Liverpool, as a means of immobilization by antero-posterior leverage in the treatment of hip disease; but it is to the principles upon which this splint is used, rather than to its general form, that the name of Thomas should be applied, for unless the splint be used upon these principles it may be a wholly worthless encumbrance.

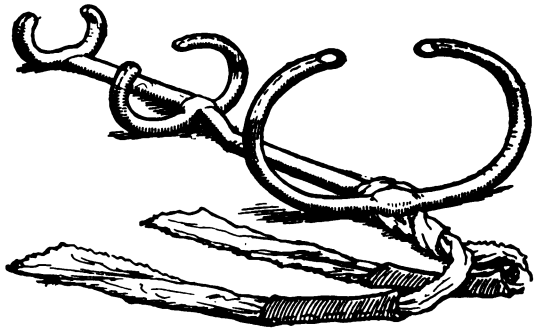

FIG. 77.—The Thomas hip splint, with shoulder straps attached. It also shows the twist of body stem.

Before the time of Mr. Thomas a somewhat similar device was used by Mr. Hilton to overcome deformity, and since the time Mr. Thomas first gave the splint to the profession others have used apparatuses looking somewhat like his splint, but wholly ineffective, either because of their shape or flexibility, or rendered useless by the addition of traction forces applied either in a latteral or longitudinal direction. The Thomas splint is intended to immobilize the hip joint by a direct antero-posterior leverage action. By this action it reduces the deformity, or opposes a tendency to deformity. By its weight and rigidity it steadies the inflamed articulation and quickly relieves muscular tremor.

The Thomas Hip Splint.—The Thomas hip splint consists of a main stem, a chest band, a thigh band, and a calf band, and

occasionally of an abduction or adduction wing passing round the flank. The splint is constructed of the softest and toughest iron. Annealed steel is not the material to be used, inasmuch as sufficient rigidity cannot be obtained without rendering the parts too difficult to easily mould to the contour of the patient.

Most serious results accrue from making splints too light, and the following practical instructions may be useful: For an adult of about six feet the upright should measure $1\frac{1}{4} \times \frac{1}{4}$ inch; for an adult of about five feet six inches the upright should measure $1\frac{1}{8} \times \frac{3}{16}$ inch; in a boy of ten the upright should measure $\frac{3}{4} \times \frac{3}{16}$ inch; for a child of five the upright should measure $\frac{1}{2} \times \frac{1}{8}$ inch; for an infant of two the upright should measure $\frac{1}{2} \times \frac{3}{32}$ inch.

The wings should be the same width, and of such thickness that they may be readily bent by hand. In length it reaches from the lower angle of the scapula to the junction of the middle and lower third of the leg, passing down posteriorly to the hip joint. In growing children it is customary to make that portion below the joint somewhat longer than that above, but

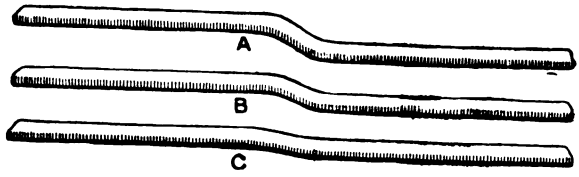

FIG. 78.—(*a*) Body stem for thin patient. (*b*) Ditto for stout patient. (*c*) For case with enlarged trochanter.

nothing is gained in immobilization by making one part longer than the other, taking the hip joint as the middle point. The upright stem is bent in two places, one opposite the fold of the buttock, the other just above the joint, so that the leg portion and body portion follow parallel lines distant from each other from one-half to two inches, this distance depending upon the size and stoutness of the patient (fig. 78).

As a rule the stouter the patient the nearer do these parallel lines approach each other. In a case where the trochanter is enormously hypertrophied the buttock bend may be entirely dispensed with, and in that case the body and thigh portions of the

upright form a straight line. The bends referred to should be rather rounded than angular, as may be seen in the illustration. The leg portion from the fold of buttock to the lower end is perfectly straight, as is the portion from the bend opposite the joint to the upper end. The stem is usually twisted somewhat in its longitudinal axis, so that the body portion lies slightly to the side and flat against the curved outline of the chest, while the leg portion lies directly posterior to the middle line of the leg (fig. 80). The buttock bend lies between the great trochanter and the ischial tuberosity. This twist varies according to certain conditions which will be hereafter referred to in describing the adjustment of the splint. The chest-band is also made of flat bar-iron, which varies in width and thickness in proportion to the size of the patient. It should be long enough to encircle the chest to within an inch or two. If the splint be made reversible so that it may be applied to either leg, as is customary in hospital work, it is joined at its middle to the upper end of the stem, whereas, if it is to be used only in a certain individual

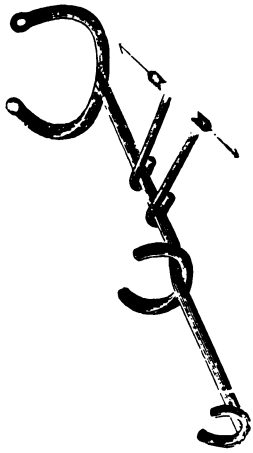

FIG. 79.—Showing how to twist the upright so that it may lie flat on patient's chest.

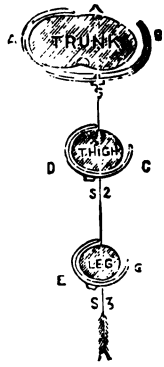

FIG. 80.—Showing how the wings on the side away from the disease are closely drawn to the body, while the wings on the diseased side are slack.

case, it is joined from one or two inches to one side of its middle so that one wing will be longer than the other. The longer wing encircles the chest opposite to the diseased side, its greater

length being due to the greater distance it has to travel. The relative length of these wings may be determined by measuring from the lower angle of the scapula around each side to the front where it is intended that they should terminate. There is no special advantage in having these wings to end opposite each other, although it may perhaps make a somewhat neater looking apparatus. The upper end of the main stem is forged flat and bent over the chest-band and the two are made fast by a single rivet. In each end of the chest-band a hole, three-quarters of an inch in diameter, is forged for the fastening of the shoulder bandage, or, what is less convenient, holes are drilled for the attachment of buckles, or straps. The thigh-band is made of flat bar-iron, and, being placed on the surface of the main stem next to the patient, is joined to it by one rivet at a point about an inch below the lower bend. If the splint is to be made reversible the wings of this band should be of equal length; if it is intended for one side only the inner wing is made an inch or two longer than the outer. The calf-band is also made of flat bar-iron, and is joined to the lower end of the stem by a single rivet in the same manner and with the same relative lengths of wings as the thigh-band. When an abduction or adduction wing is required it is made from the same size iron as the thigh-band.

This should be placed at such a point that it will pass around the flank midway between the crest of the ilium and the ribs. This point is usually about midway between the buttock bend and the chest-band. The wings or bands are bent approximately to fit the imaginary patient, and the surface of the entire splint next the patient is covered with felt, either harness-makers' felt, or what is better, ordinary boiler felting of one-fourth inch thickness. The whole is then covered with that kind of sheepskin known to the trade as basil leather or "tan sheep." This

FIG. 81.—Wrench for bending and fitting the Thomas hip splint.

should be put on wet and snugly stitched into place, so that as it dries the shrinking will prevent any slipping upon the iron. The stitching of this leather is of course done on the surface of the splint away from the patient; it may be done with the so-called ball-stitch, or, what is more servicable but less neat, the two edges of the leather may be drawn up together and sewed through after the manner of the harness-maker with a double waxed end; the redundant portion of the leather is then trimmed off.

The splint is applied while the patient rests upon his back, the wings upon the side away from the deformity being opened out sufficiently to slide the splint under the patient from the affected side without unnecessary jar or movement. When the main stem rests in place, the leg portion will be directly behind the middle line of the thigh and leg, the part between the bends directly at the back of the hip joint, and the body portion somewhat to the outer side of this line, the whole lying flat against the chest, thigh and leg. This fitting may be done approximately by the hands, but better by wrenches (fig. 81). The wings to the inner side of leg and thigh and the wing of the chest-band on the same side, namely, those on the side away from the diseased articulation, are drawn more closely than those on the affected side (fig. 80). The reason for this is that the splint tends somewhat to the affected side of the patient and to draw the leg into abduction.

Particular attention must be paid to the bending of the body wings. As the chest is not circular it is necessary that the body wings should not be made circular else intolerable soreness will

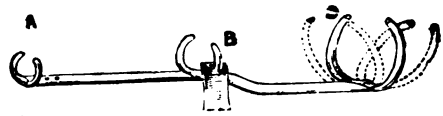

FIG. 82.—Showing method of making splint longer or shorter.

result. By closely examining fig. 80 this will be seen. The part between A and B upon which the patient lies is but very slightly curved and this allows the body to rest comfortably and travel easily towards the diseased side B, which is of great advantage. Fig. 77, which is fairly correctly modelled, may be

compared with the diagram, which represents the almost circular erratic body wings.

Another very simple expedient consists in making a small

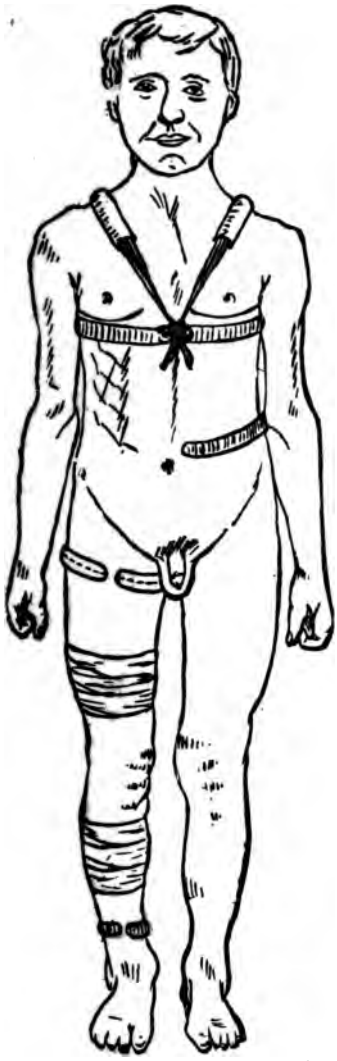

FIG. 83.—Showing splint with abduction wing.

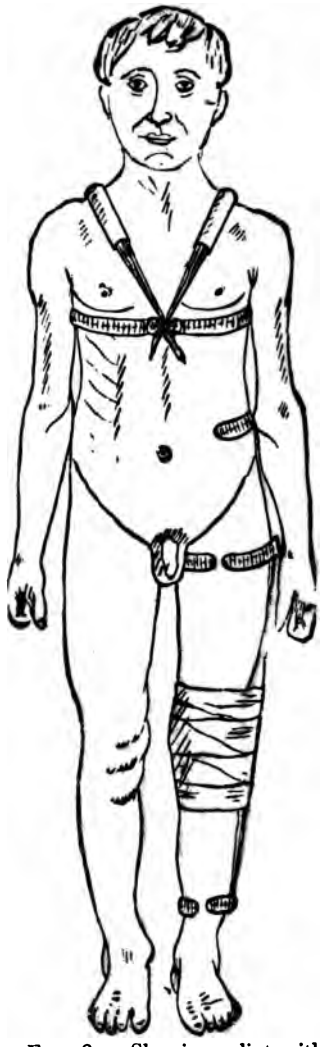

FIG. 84.—Showing splint with adduction wing, and also device to correct internal rotation.

hole in the bandage and passing it over the outer of the thigh wings and rolling it under splint and thigh and round the limb, so that the appliance is pulled in the opposite direction to that which

FIG. 85.—Splint with one wing of chest band drawn down to act as abduction wing.

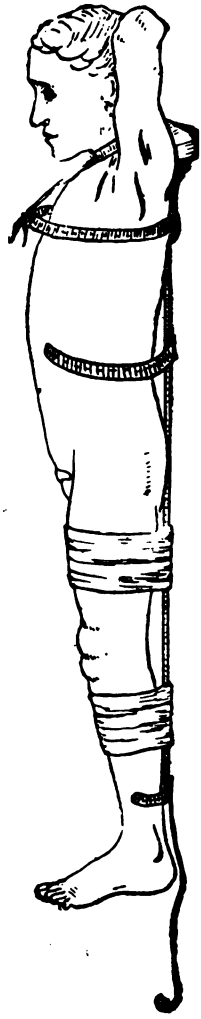

FIG. 86.—Nurse attached.

it tends to travel. When satisfactorily fitted a short piece of bandage is wrapped around the splint and leg at the lower extremity and pinned securely, and another wrapped around the thigh above the knee, or, what serves in some cases more satisfactorily, a single piece is wrapped around the knee in the figure-of-eight fashion and pinned with a large pin directly through the covering at the back of the splint, so that the bandage cannot slip upon the splint, and any tendency of the splint to slip downward is avoided.

If the splint be found too large, or, as when the patient grows, too small, it may be necessary to modify or increase its length. This is quite simply done. If it be too large draw both body wings towards the abdomen; if too short draw them toward the neck. The dotted lines (fig. 82) will explain this. A strip of broad bandage is then looped around the upper end of the stem below the chest-band, and having been twisted two or three times so that the ends will separate high upon the back, each end is carried over a shoulder and brought down to the hole in the end of the chest-band like a pair of braces (fig. 77); here each is tied securely, crossed to the hole at the opposite side and again tied, when the ends are finally knotted (figs. 84-85). The final knot should be secured either with a long pin driven through it and twisted at its end, or with a bit of adhesive plaster.

The splint should be applied without bending it from the shape already described if it is possible to force the leg at the knee reasonably near the splint. The lumbar spine readily curves when there is flexion at the hip sufficiently to allow the limb to be brought down to the splint when there is as much deformity as fifty degrees; but if the deformity be very great, as much, perhaps, as ninety degrees, it may be necessary to bend the splint just enough to get the limb in contact with it when the fullest possible lordosis has been obtained.

In these cases the bending is done at the upper bend of the main stem directly at the back of the hip joint. In practice, however, this will rarely be found neccessary, and has its disadvantages.

If there exists any considerable degree of abduction a wing should be attached as already directed, passing around the flank

piece is called a "nurse," and will be found, when children are restless, a safe precaution during the period of recumbency (fig. 86). If severe leverage be brought to bear over the buttock in order to reduce a marked and rigid deformity, care should be taken to shift the skin about twice a day where it presses with most force on the stem (fig. 87), and to see that all parts about the hips are kept clean, dry, and well powdered, otherwise pressure sores may result.

If the splint has been bent to fit the deformity, it must be straightened as soon as possible, sufficient opiate being given to quiet the pain during the few hours or days of the reduction of the deformity. During this time, of course, the patient must remain in bed, and recumbency should be maintained until all pain and intense muscular spasm has subsided. When the deformity has been reduced the leg should be scarcely at all interfered with, the splint should not be removed, motion should not be tested, even the bandages at the knee should not be changed except they become slack or soiled. The most absolute quiet to the joint and to the patient must be enjoined, and the necessities of nature should be attended to by gently lifting both lower extremities and inserting the bed pan. This can be done without causing pain in even the most sensitive joint. The good limb is placed gently across the diseased one, and the nurse lifts the patient by placing one hand under the splint just below the knee, while with the other she lifts the chest-band (fig. 88). When all pain, tenderness, and muscular spasm have been quiescent for some weeks, and when no sign of fluctuation can be made out about the joint, the patient may be allowed to arise and get about on crutches, aided by a patten on the sound limb. The patten consists of an iron ring with two uprights, the ring resting on the ground and the uprights rising from the front and back, reaching to the shoe and fastened to the heel and sole (fig. 89).

The ring is oval shaped and is made of square bar-iron not less than three-eighths of an inch thick. It reaches from the ball of the foot to the middle of the heel and its width is slightly more than that of the sole of the shoe. The uprights are of round bar-iron set at right angles to the plane of the oval ring, and should at their lower ends be welded to it, their upper ends

FIG. 88.—Showing how to carry patient.

FIG. 89.

FIG. 90.

are forged flat, pierced with three holes and bent forward. If the patten is to be attached to a thin-soled shoe it will be better

to rivet these flattened ends to a metal plate shaped to fit the sole of the shoe and screwed to it. The height of the patten depends upon the size of the patient and should be from four to six inches, high enough to prevent the patient from reaching the ground with the toe of the affected side. This with the ordinary axillary crutches completes the walking outfit (fig. 90).

For the most perfect result the patient should he kept recumbent until all pain, tenderness and muscular spasm have subsided. He may then walk about on crutches and patten until all the soft tissues about the joint are well athrophied, and all trace of the disease has disappeared.

The patten may be then dispensed with and the crutches shortened, and in this manner he may go about for two or three months. If there be no evident return of the disease the crutches may now be thrown aside and the joint further tested by two or three months' use. All still going well, the splint is cut off at the knee so as to permit of flexion there, a band being attached at the lower end after the same manner as the calf-band (fig. 92).

FIG. 91.—Testing for recovery.

This short walking splint having been worn for two or three months and there being no return of the symptoms of the disease the splint is removed at night for a month or two. If the joint remains well the splint is removed for certain hours during the day and then altogether, and the joint finally tested for perfect cure (fig. 91).

The joint should be imprisoned long after the appearance of disease has gone and after all subjective symptoms have disappeared, for the sensations experienced by a patient recovering from articular disease cannot be very reliable under the masking influence of a splint. The test comes on removal of restraint, and a very critical time it is unless the surgeon has grasped the knowledge whereby such a test becomes reliable. No surgical text book gives any allusion beyond vague generalities to the means of knowing the right moment to discard the treatment. There is no more danger of relapse in cured joint disease, than there is of disease in a healthy articulation. But if a joint be pronounced fit for use when the remnants of inflammation have not gone, it is easy to understand the very frequent references to relapse which meet us everywhere. The law may be again laid down: a joint is cured of disease where the range of movement does not diminish by use, or in those cases resulting in anchylosis a cure may be pronounced where the angle does not change after use.

All patients should be examined at the commencement of treatment for the purpose of diagnosis and record, and again at the close of treatment for a comparative record and for the diagnosis of a cure. In each instance the patient should, if it is practicable, be entirely stripped of all clothing the attitude should be noted in standing, walking and lying, the amount of motion at the articulation compared with that of the sound side, the member measured for both real and false shortening, for abduction, adduction, flexion and atrophy.

It is our effort to encourage rather than otherwise the production of abduction in the cure of hip disease. It diminishes the amount of practical shortening caused by displacement, erosion, or arrest of growth. By recognizing this, we are sometimes able, where there is perhaps two inches actual shortening, to slant the pelvis sufficiently to render the apparent or practical

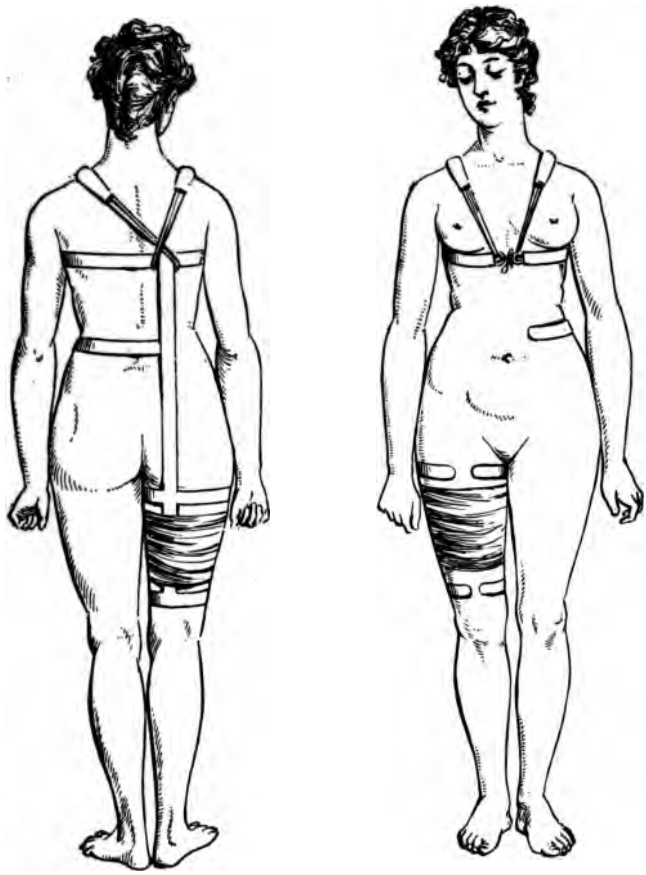

FIG. 92.—The short, or walking brace used during convalescence.

measurements equal on either side. Adduction although often inevitable should be energetically combated. Mr. Thomas used to sling a bag of shot around the pelvis, the weight being attached to the side it was desired to depress.

To render the pelvis flat in a definite position it is customary for us to put the patient in what is known as Thomas' "flexion-test" position (figs. 93, 94 and 95). This consists in flexion of the thigh of the sound side upon the trunk, so far that the elbow of that side can be hooked into the flexure at the knee and the forearm carried across the body. This gives a sufficiently defi-

nite position to render measurement, made at different times by the same or different surgeons, comparatively accurate, although unless the surgeon be careful, flexion to the Thomas position in some cases tilts the pelvis upwards and renders the record of deformity not only that of the existing flexion but also that of the amount of normal extension.

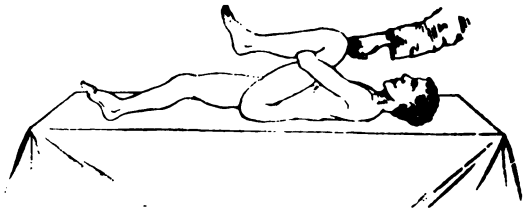

FIG. 93.

FIG. 94.

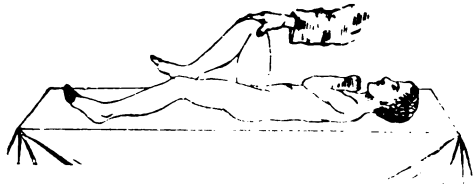

FIG. 95.

These deformities may, perhaps, be more accurately measured with the goniometer, but the measurement with the tape is generally more convenient, and is sufficiently accurate. The amount of muscular atrophy of both thigh and calf should also be recorded. This may be done by measuring the circumference of the limb at points similarly placed on both limbs. The degree to which motion is possible in the antero-posterior direction may be ascertained in the same way as the deformities are

be noted, the location of sinuses and their character, and the nature of the discharge. The advent of an abscess is usually first ushered by increased pain, muscular spasm and increase of deformity. Tenderness may often be made out on palpation, and sooner or later, induration or a boggy feeling is manifest. This usually is first felt directly in front of the joint, although it may appear posterior to the greater trochanter, or in fact at any point in the neighborhood. As the abscess increases in size it usually extends downward and may come to spontaneous opening within a few weeks, or not until after many months.

It does not appear to us that anything is to be gained, and often much may be lost, by early operative measures upon the abscess of hip disease, provided there are no constitutional symptoms of septic infection. An abscess opened early invariably conducts to carious bone, and generally to a joint extensively diseased. Rarely can all the tubercular material be removed without a complete excision of the upper portion of the femur and of the acetabulum. Unless all diseased tissues be

FIG. 97.—Showing unhealed sinus, where the patient has been able to play about in walking outfit.

emoved, a sinus is likely to remain which may subject the patient to septic infection. An abscess left unopened for some months often descends a considerable distance and becomes cut off from the original focus. In such a case careful operative measures without drainage should result in immediate closure and primary union, but it is not easy to tell when the abscess is no longer connected with diseased bone or joint, and the surgeon who interferes takes a very serious responsibility. He should not, in our opinion, open such an abscess unless he can be reasonably sure of removing all tubercular material, and of closing the wound without drainage. The use of a drainage tube leads to the formation of a tuberculous sinus, which is exceedingly difficult to heal (fig. 97), far more difficult than a sinus resulting from spontaneous opening. When operative measures are undertaken we believe that the tubercular tissues, whether sac of abscess, wall of sinus, synovial membrane, cartilage, or bone, should be removed by cutting with a knife or chisel, instead of the scratching and scraping to which such tissues are usually subjected by the so-called sharp spoon. There can be no question that the risk of general infection is greater from a cutting operation than where none is done, but the risk is much increased by the scraping process. In considering the treatment of these abscesses it should be remembered that a very considerable number of them, if left to themselves, the joint being put at complete rest, never go on to an opening, but gradually dry up and disappear without any apparent ill-effects to the health of the patient.

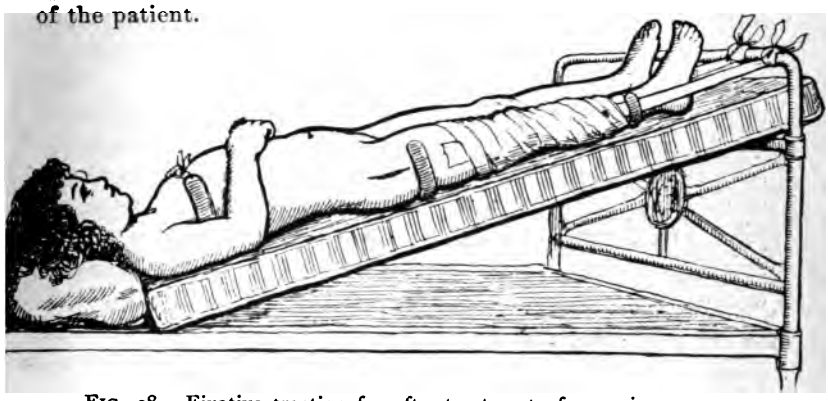

FIG. 98.– Fixative traction for after-treatment of excessive cases.

If it were certain that every abscess would come ultimately to the surface, or if there were any reason for believing that the health of the patint suffered from allowing them to remain un-

FIG. 99.—Extreme deformity in neglected hip case.

opened, or from their being re-absorbed, operative measures would be justified in all cases; but as there is no way of knowing what is to be the course of any given abscess, we believe that the indications for operative interference should be made to depend upon the general health of the patient, and that no abscess should be opened unless the patient's health be unquestionably suffering from its presence. We would make the same rule regarding other operative procedures, such as the removal of the focus of disease within the bone, excision of the joint, and amputation. If any case in the recumbent posture should grow progressively worse under efficient immobilization of the joint, then the best obtainable hygienic operation for the removal of the disease would be indicated; but we have not seen such a case until after it had been allowed to go on to an exceedingly advanced stage without any treatment whatever.

The preservation of the patient's life, then, we would make the only indication for an excision of the hip joint, or for an amputation. The operation for excision, or for amputation, need not be described here, since they are found in all works on general surgery, but if excision be performed, thorough mechanical treatment following the operation is indicated and should be the same as in the treatment of any unsound articulation. This after-treatment we think is often neglected by the general surgeon, and may account for some of the relapses which have been reported. The mechanical treatment of these cases, consisting of immobilization and protection to the joint, should be continued until every evidence of unsoundness has been absent for a very considerable time. The hip splint, used after an excision, should be supplemented by the addition of fixative traction as is done in some cases of fracture of the upper portion of the femur (fig. 98). A strip of adhesive plaster is applied to each side of the limb from the upper portion of the thigh to the neighborhood of the calf-band of the splint, the lower ends of these strips are then carried around the wings of this band, so as to secure the necessary traction, and fastened securely, and the splint is adjusted without the usual shoulder straps. While the patient, without shoulder straps is lying in bed the splint tends to work downward sufficiently to overcome the muscular contracture which would produce unnecessary shortening.

At times old and neglected cases will present themselves for treatment with a serious deformity, and the question arises as to whether any operative measures are demanded (fig. 99). If muscular spasm be evident on attempting motion at the joint even if there be no possible motion, or if an apparently sound joint possesses a certian degree of motion, the deformity can be corrected in a comparatively short time by the leverage action of the splint; or the deformity may be corrected at once, or nearly so, by anæsthetizing the patient and placing the limb in the best possible position. In these cases we do not recommend section of the tendons, fasciæ or other contracted tissues, although there may be no very serious risk in their division. To this subject, however, we will return again. We think it safer to divide the femur with the chisel either through the neck or in the neighborhood of the lesser trochanter than to attempt a fracture by

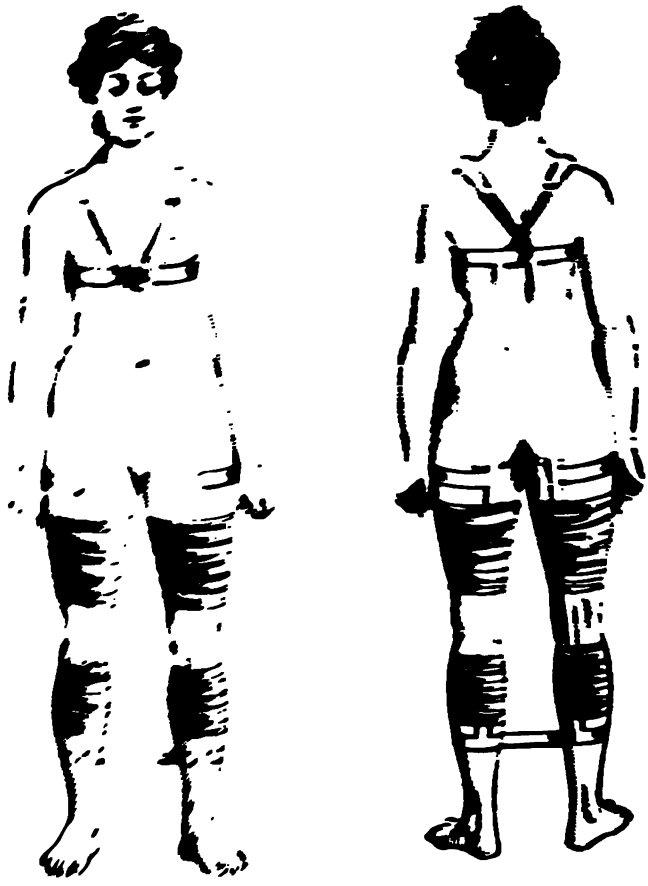

Fig. 22. The double hip-splint.

that question. The after treatment of either of these operations is the same as indicated after an excision of the joint. The patient should remain in bed until union is sound, when the splint may be removed and he may remain in bed, an equal time, without immobilization, or in place of recumbency, in certain cases, the splint may be cut off at the knee and the patient allowed to go about with splint and crutches, without the patten, for a period equal to that which was required for the union of the bone.

Cases occasionally appear with abscesses or sinuses so placed that pressure cannot be borne from the main stem; it is then customary to immobilize by the double hip splint with a longer or shorter section of the main stem on the affected side removed. The double hip splint, which is used in all cases of hip (fig. 100) disease affecting both joints at the same time, and in some cases of young children where the joint sensitiveness in single hip mischief is extreme, consists of the chest-band already described, from which two main stems pass at a point opposite the lower angle of each scapula downward, posterior to each hip joint and down the back of each limb, and separate at the bottom by a distance from four to eight inches. The lower ends of the main stems are joined by a straight bar of iron, the inner wings of the thigh-bands are usually omitted, and we generally add a lateral wing to each side. Upon this splint the patient can be moved from bed to a couch or to a carriage with very little inconvenience or pain. Cases of double hip disease are not so very infrequent, occurring perhaps in the ratio of one to one hundred of single hip disease. The disease rarely begins in both joints at the same time, and it occasionally develops in the second joint, while the patient is lying recumbent and protected from all traumatism during treatment of the first joint.

Under these circumstances it frequently occurs that the joint last attacked recovers first, though not invariably with the greatest amount of motion. Partial or complete anchylosis of both hip joints resulting from double disease is not so very serious if the lumbar spine be sound and flexible, and provided the limbs be in relatively normal position. Patients are able to walk and to climb stairs, to sit, and to perform most of the ordinary movements of life fairly well. The results of double hip disease, treated by the Thomas double hip splint, appear to be somewhat better than the results of disease in single joints. The nature of the affection is such, that prolonged recumbency is necessitated, and walking is impossible before recovery has become nearly complete.

In hospital practice and among the very poor and ignorant, it will be often found impossible to keep the patients in bed with single hip disease as long as we have indicated to be desirable, and it will also be found impossible in all young children and in

many older ones to compel the use of the high patten and crutches. Parents will permit these children to walk and bear their weight upon the diseased limb. As a matter of fact these cases do better than we might expect. We have observed many

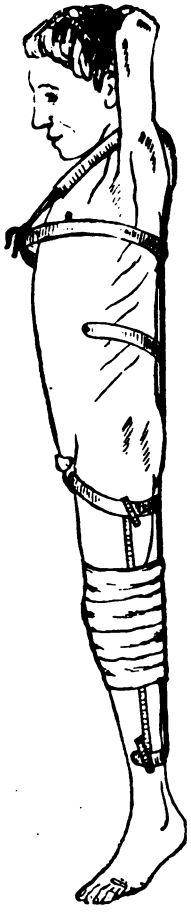

FIG. 101.—For the prevention of knock-knee complicating coxitis.

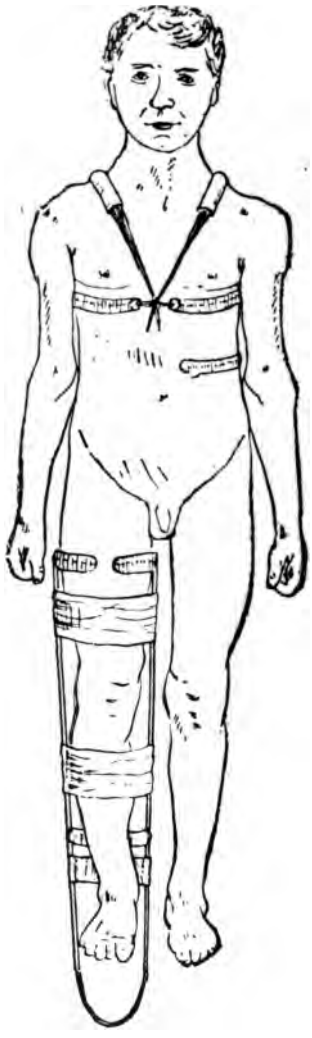

FIG. 102.—For knee-joint disease complicating coxitis.

such, and find that some recover without flexion, rarely with adduction, and with very little, and sometimes no shortening. The number that have partially stiff joints is greater than among those where treatment has been carried out in accordance with correct theories.

Now and again during the development of abscess a case will present so intense a degree of spasm of the adductor muscles that, if the patient remains fixed in the ordinary splint, knock-knee will result from adduction of the thigh, the lower portion of the leg being held by the lower part of splint.

This complication is prevented or corrected by passing a light bar of iron from the thigh-band to the calf-band, along the outer side of the leg, and bandaging the knee to this band as well as to the main stem (fig. 101).

In cases where disease at the knee-joint appears at the same time with disease at the hip, the knee may be immobilized by joining the knee and hip splint together, or by adding to the hip splint a light band of iron passing down each side of the leg and around somewhat below the foot, and riveted to both inner and outer wings of the thigh and calf-bands (fig. 102).

In cases of spondylitis of the lumbar region, occurring at the same time as the disease at the hip, the back may be protected by a stout sling of leather, passing from one main stem to the other of the double hip splint, or the main stem with its thigh and calf-bands may be attached to a spinal support.

DISEASE KNEE-JOINT.

Chronic disease at the knee-joint, commonly called a white swelling, or tumour albus (fig. 103), is the same in character as disease of the hip and spine. It either commences as a tubercular process or very soon becomes so. Tuberculosis and syphilis in the parents predispose to its development, as do the acute infectious diseases of childhood, and all those conditions which

Fig. 103.—Showing a tubercular knee.

tend to deteriorate the general health in adult life. Traumatism, however, plays a more important part in its causation than in the diseases either of the hip or spine. The situation of the knee exposes it to frequent contusions, and no joint except the ankle is more subjected to sprains.

Disease commences more frequently as an osteitis than a synovitis, as in the other joints; nevertheless, the relative number of cases commencing in the synovial membrane is greater here than elsewhere, and apparently this can only be accounted for by the frequency with which the articulation is exposed to injury. From bruises and wrenchings some degree of simple synovitis results; this is neglected because of the mildness of the symptoms, and it ultimately becomes in predisposed subjects the seat of tubercular infiltration. When the synovitis ceases to be simply traumatic and becomes tubercular we do not know; it appears more than probable that there is no definite time, and that it depends very much upon the constitutional peculiarities of the individual. We have observed cases in which there was no positive evidence of tuberculosis for many months after the onset of the simple inflammation, while in others tubercular synovitis commences without any remembered injury. It appears to us that, even in those not predisposed to tuberculosis, a neglected simple synovitis, should it fail to spontaneously recover, may ultimately become tubercular. Tubercular synovitis, whether arising from a neglected injury or as a primary infection, is usually diffused throughout the entire lining of the joint; only when secondary to an osseous focus have we seen it limited to a comparatively small area.

FIG. 104.—Showing old contracted knee.

Tubercular osteitis, here, as in other joints, may begin as a primary or a secondary focus. Its site is usually in the epiphysis, more frequently than elsewhere, of the internal condyle of the femur, next in frequency in the head of the tibia, and least frequently of all in the patella. The course of the osteitic

tuberculosis is the same, in a general way, as elsewhere, and the joint cavity usually becomes involved.

Prognosis.—The prognosis of disease at the knee joint may be said to be good. The patient rarely succumbs to the disease unless the shaft of the femur or tibia becomes involved. Untreated, the leg becomes flexed on the thigh and somewhat abducted and rotated outward, the flexion seldom exceeding 45 degrees, and, if anchylosed at this angle after recovery, can be used in walking without crutch or cane (fig. 104). In severe cases, however, the tibia may become subluxated and the outward rotation and knock-knee may be so great, that the limb is practically useless. Tubercular abscess occurs somewhat less frequently than at the hip, but when present is no bar to a good result. Knee joint disease, untreated, results, as a rule, in anchylosis or greatly restricted motion, and that usually with considerable deformity.

When diseases of the knee are subjected to efficient mechanical treatment the results are better as to deformity, function and duration than is the case in any other of the larger joints. In no case, unless the disease has been accompanied by great displacement for a long time, should there be recovery with deformity, and anchylosis should rarely remain; and this holds good even when great destruction has taken place, provided there has been no subluxation backwards, or the rarer deformity of hyper-extension of the tibia on the femur (fig. 105).

Symptoms.—At the knee joint, more frequently than elsewhere, do we find the difference between a synovitis and an osteitis clearly defined in the early stages of the disease; later on the dividing line fades away, one condition merges into the other, and we have all the positive symptoms of both synovitis and osteitis. At this time an excision will reveal more or less complete tubercular infiltration of all the structures composing the joint.

It is not necessary to detail the symptoms of an acute traumatic synovitis; with such a condition we have nothing to do, but, some weeks or months later, when the acute symptoms have disappeared, there may remain, in those predisposed to tubercular affections, and in those too impatient to give the time and attention necessary for a complete cure, a certain disability.

The joint may not be found to be quite as strong as formerly, it may tire more easily, there may be slight limping after a long walk or towards the end of a day's work. Examination reveals a slight increase of the fluid normally in the joint; the bony outlines are less distinctly seen; the patella may or may not float when the limb is fully extended; and when the synovial sac is compressed, both above and below, there is a slight springy resistance to full extension; there is also usually some tenderness to pressure over the internal lateral ligament. Rarely is there any complaint of pain, any local elevation of temperature, or any general tenderness. This condition may remain, with little, if any, change for many months, but ultimately the bony outlines become less and less distinct, circumferential measurement with the tape shows a considerable increase in the size of the joint, and the part assumes all the characteristics of a tubercular synovitis, and follows its usual course.

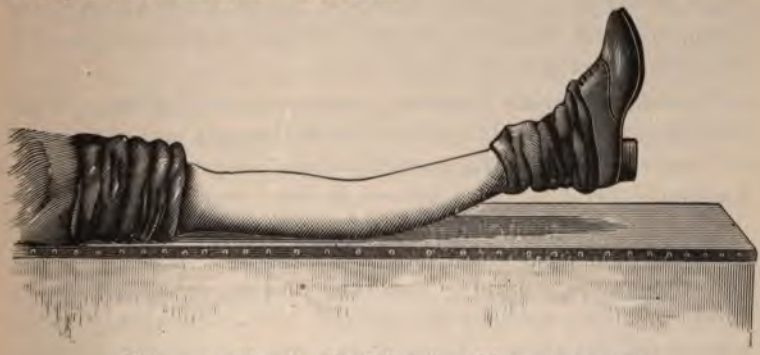

FIG. 105.—Showing the deformity of hyper-extension.

A tubercular synovitis may commence without any remembered injury to the joint. The first disability noticed is a slight limp after unusual fatigue, and an examination reveals the bony outlines obscured by a pulpy, semi-fluctuating distension of the joint. There is no pain or restlessness in sleep; no local heat or tenderness to palpation; no floating of the patella or true fluctuation; no atrophy of the muscular masses above and below the joint; there may or may not be increase in size of the joint by circumferential measurement, and motion is practically normal. Less frequently than in the traumatic cases is there limitation to full extension, full flexion being the first motion restricted. The

restriction is springy in character, and evidently due to the thickening of the joint capsule, and a very different affair from the resistance occasioned by the involuntary muscular spasm which accompanies a tubercular osteitis. These cases, as a rule, progress very slowly, but sooner or later the bone is invaded by the tubercular growth, and the symptoms of an osteitis are added to those of a synovitis. Fig. 103 illustrates such a case, where swelling had been present for four years, and where, only within a few weeks, had there been stiffness at the joint or a tendency of the leg to become flexed, and where as yet there had been no pain and no tenderness.

Tubercular degeneration may be considerable, and true fluctuation within the capsule may appear; the joint may even rupture, and sinuses form, but this is rare before the bone becomes involved. More often some shrinking of the new tissue takes place as the bone becomes involved, and at times all swelling disappears, and the joint presents only the characteristics of a tubercular osteitis of the dry form.

Tubercular osteitis invariably commences with a limp. This may be noticed for only a short time in the early part of the day, and days together may pass without any limping at all. After a time the child becomes restless in sleep and may scream out during the first hours of the night. Rarely is there any complaint of pain until much later in the disease. Examination at this time reveals nothing abnormal in the appearance of the joint; the bony outlines are distinct, and no swelling can be seen or felt anywhere. There is, as a rule, some slight elevation of the local temperature, and there is often some bony point distinctly tender to firm pressure. More often than otherwise this tender point is on the inner and lower surface of the internal condyle of the femur. There is always present the involuntary muscular spasm, characteristic of tubercular osteitis, restricting to a greater or less extent the normal motions at the joint. The full degree of flexion is first lost, and soon the leg cannot be fully extended. Shrinking of the thigh and calf muscles comes on early, and, with the involuntary muscular spasm, make the only constant and characteristic diagnostic symptoms. The degree of possible motion gradually diminishes, and false anchylosis results; the leg is flexed on the thigh to an angle of from

135° to 90°, some outward rotation and abduction of the leg on the thigh takes place, and walking becomes difficult. By this time, and in some cases much earlier, pain is complained of and may be very severe; the condyles of the femur become broadened and thickened, but in some cases the head of the tibia is the part alone involved. The synovial membrane may be invaded by the tubercular growth, or a tubercular focus may rupture into the joint, and the whole membrane become at once infected. Now all the positive symptoms of tubercular arthritis may be said to be present. Tubercular abscesses form in very many of the untreated cases, and, opening spontaneously, may lead into the joint or only into bone cavities.

In rare cases the onset is sudden, and both bone and synovial membrane appear to become affected at the same time. In these cases the symptoms are severe, the progress rapid, and few joints escape rupture if not opened by the surgeon.

Multiple osseous foci are rarely found, but we have observed a focus at the inner condyle (which infected the synovial membrane by contiguity and did not go on to the formation of a tubercular abscess) coincidently present with a focus in the region of the epiphyseal line on the outer side of the bone, which led on to liquefaction and spontaneous opening.

Differential Diagnosis. — Of the conditions which simulate tubercular disease of the knee-joint none is so difficult of differentiation as the hysterical affection. It usually imitates the osteitic form of disease, in which there was no change from the normal contour; but in the shapely limb of a well-developed young woman, supplied with an abundance of subcutaneous fat, pseudo-fluctuation of tubercular synovitis in the early stage may be closely simulated. In these cases we have only the presence and exaggeration of subjective symptoms to aid in making the diagnosis, and we cannot escape the knowledge that is it impossible for true tubercular disease to be present in a hysterical patient as well as in another. The imitation of tubercular osteitis is even closer. The patient walks with a limp, complains of pain, the leg is somewhat flexed, the joint motions are restricted, there is tenderness to pressure and increased heat about the joint, and the circumferences of thigh and calf may be less than those of the other side. Practically, all the symptoms except the tuber-

cular abscess may be present, and only the trained eye of the neurologist, accustomed to recognize hysterical manifestations, or the hand of the surgeon, practised to appreciate the resistance of the involuntary spasm of true bone disease, may be able to make the diagnosis. On one occasion certainly a knee-joint has been laid open for excision and found perfectly healthy by a surgeon who disregarded the diagnoses of a neurologist and an orthopedist. As a rule the hysterical joint is not accompanied by muscular atrophy of the thigh and calf, and the absence of this symptom would always be regarded as a significant fact. Muscular atrophy, however, does arise from disuse, and when present must not be taken as positively conclusive evidence in favor of a tubercular inflammation of the bone ends.

The acute traumatic synovitis should be readily excluded on account of the history, the heat and pain, and the fluidity of the contents of the greatly distending joint capsule.

The differentiation from rheumatic inflammation should be readily made. In rheumatism, the suddenness of the onset and the acuteness of the symptoms are out of all proportion to that which ever occurs in tuberculosis.

The results of a gonorrhœal or septic inflammation of a joint somewhat resemble certain cases of tubercular disease, and, if the history of the case be concealed, as it sometimes is, may be confusing. In these cases, during the acute attack, the diagnosis is readily made because of its acuteness; when the acute symptoms have passed, a certain amount of induration is more dense to the touch than in tubercular synovitis, and is always accompanied by restricted motion at the joint. The restriction is a mechanical one resulting from the inflammation, and in no way feels like that given by involuntary muscular spasm. If there is doubt about the character of the resistance, an anæsthetic will settle the question. Rigidity due to muscular spasm will be lost; that due to the results of an inflammatory process will be partly present.

A spinal arthropathy, happening to follow a traumatism, might puzzle one not accustomed to handle joints. In these cases the bone ends are increased in size without being tender to pressure or accompanied by pain; the joint distension is more fluid to the touch, and may contain semi-detached masses, firm, and of con-

siderable size, the joint mobility is great, soft crepitus may be heard or felt, and the patients almost invariably present some other indication of locomotor ataxy.

Treatment.—As at other joints, the treatment of the disease may be mechanical or operative; and with the exception of the elbow, no joint is more favorably placed to give a rapid and satisfactory result whichever line of treatment be chosen.

The principles of the treatment are the same as elsewhere; complete immobilization from the earliest possible moment until a cure has been effected, and relief from weight-bearing until convalescence is well established. When deformity is present it should be rapidly corrected, since the healing process cannot go uninterruptedly forward while the angle of flexion is changing, and since recovery takes place much more rapidly with the limb in full extension, and with a far better functional result. The deformity may be best corrected by the greatest continued leverage force that can be tolerated, accompanied by fixative traction, or the same thing may be accomplished by careful manual correction under an anæsthetic, followed by complete immobilization.

Plaster-of-Paris, which has been used more extensively in disease at the knee than elsewhere, cannot be depended upon, and should only be used temporarily while a proper splint is being obtained. When used (and a better substitute can always be found), it should extend from the ankle to the perineum, and in severe cases, as the leg cannot be prevented from flexing, it should be commenced at the toes and carried to the waist. All splints that are shorter than the distance from the foot to the pelvis lose enormously in effective immobilizing power, and those adjusted with innumerable screws and rachets are expensive and of little use. It is a pet delusion of many surgeons that intra-articular pressure can be relieved by traction through adhesive plasters applied to the skin. These are applied to each side of the leg from the knee downward for the traction force, and to the thigh from the knee upwards for the counter-traction, the adjacent ends of the upper and lower plasters being apart but an inch or two. We have even seen them applied so that the upper and lower pieces overlapped, and this by an orthopedic surgeon in an orthopedic institution; the absurdity of the

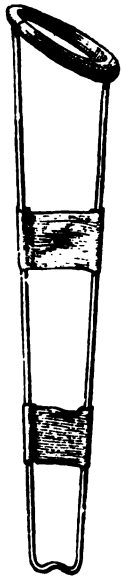

FIG. 106.—Showing a Thomas' knee-splint.

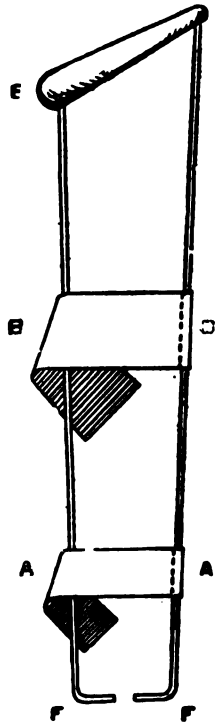

FIG. 107.—Showing a Calliper-splint.

FIG. 108.—Walking knee-splint now rarely used by authors.

arrangement, as a means of traction on the bones, being ignored and even denied when pointed out, since the patient improved somewhat during treatment. Any traction splint to be effective must extend to the tuberosity of the ischium for its point of resistance in counter-traction, and if used as a walking splint, must extend below the foot. As a matter of fact none of the splints designed with the central idea of giving traction are so constructed.

The splint, which we recommend, is known as the Thomas knee-splint, and is now used in only two forms: the bed-splint and calliper (figs. 106 and 107). That form of the splint shown in fig. 108, which is fitted with a patten at the bottom, is no

longer used by the authors, and was not used for some years by the late Mr. Thomas in any but very exceptional cases.

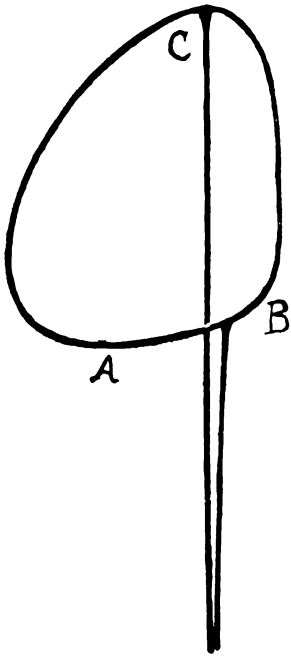

FIG. 109.—Showing unpadded ring of knee-splint. The inner bar B is placed more anteriorly than C. Tuberosity of ischium rests on A, or lowest part of ring.

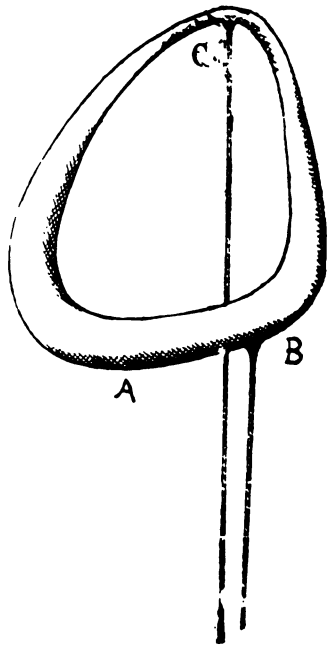

FIG. 110.—The ring padded.

The bed-splint consists of a ring of round iron to which is welded a long loop of the same material, going some inches below the foot. The ring, in shape, is an irregular ovoid flattened in front, and drawn out at the posterior and inner outline of the thigh, and, as here observed, the inner rod of the loop B is joined more anteriorly than the outer rod C (figs. 109 and 110). The ring slopes from without inward, and from before backward in such a way that the point A upon which rests the tuberosity of the ischium is the lowest part of the ring; fig. 111 shows front view and fig. 112 the back view. The angle formed by the plane of the ring and the inner bar is about 135 degrees, and the

anterior angle formed by the antero-posterior plane of the ring and the inner bar is about 145 degrees (fig. 113). The thickness of the iron depends upon the weight of the patient and is from three-sixteenths to three-eighths inch.

In making the ring the ends should be joined by welding, and the side bars of the long loop are joined to the ring in the same manner. Few surgical instrument makers are good blacksmiths, and therefore find it easier to braze than to weld, but a brazed

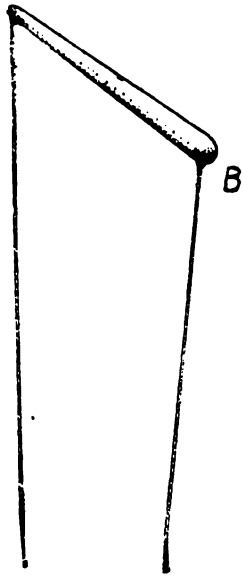

FIG. 111.—Showing front view of ring.

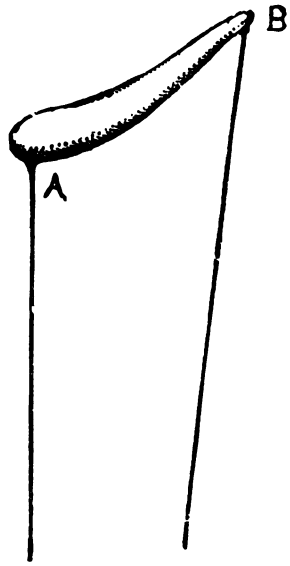

FIG. 112.—Showing back part of ring.

joint breaks on bending, while a welded joint holds fast. The lower end of the long loop is dimpled somewhat to receive and retain the straps from the adhesive plasters. The ring is padded with boiler felting to the thickness of about half an inch on its outer portion, and from one to one and a half inches in thickness at the inner posterior portion upon which the tuberosity of the ischium is to rest, and then covered with basil leather, or tan sheepskin, put on wet, and sewed after the manner of the harness-maker along the lower and outer border of the ring, where the seam will not chafe the patient. Two strips from

three to four inches wide of the same leather are sewed by one end to one of the side bars, the other end being left free and of sufficient length to be drawn across to the opposite bar, and when sewed there to form a support for the back of the limb when the splint is applied; one of these strips is to be placed at the back of the knee and the other at the back of the ankle.

The splint is applied by slipping the ring on over the leg and pushing it well up against the tuberosity of the ischium. If fixative traction is to be used strips of strong adhesive plaster, in width about one-fourth the circumference of the leg, and in length equal to the distance from the knee to the ankle, to the lower ends of these strips pieces of strong tape, webbing, or muslin bandage, having been sewn, are applied to the outer and inner surfaces of the leg. If these pieces of adhesive plaster are supplied with narrow, oblique, lateral strips for winding around the leg, they will remain much longer attached to the skin. The plasters applied are held in place by an ordinary roller bandage. The surgeon now grasps the patient's foot and pulls steadily downward, at the same time pushing the splint upward, and having straightened the limb as much as the patient will tolerate, ties the tape terminations of the adhesive plasters at the dimple at the lower end of the splint. A still better way consists in threading the loops attached to the end of the extension strips with strings, and, after pulling, winding in special fashion the string on either side round the bars of the

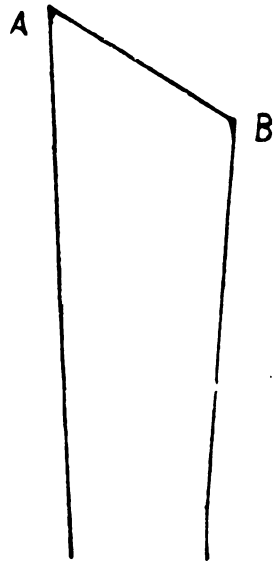

FIG. 113.—Showing angle of attachments of uprights to ring.

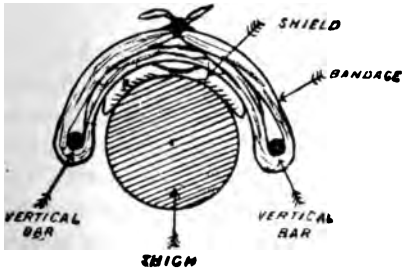

FIG. 114.—Showing how pad puts pressure on thigh.

splint until they meet below, where they are tied. By this expedient all pressure on the ankle is avoided, and the tension is longer maintained.

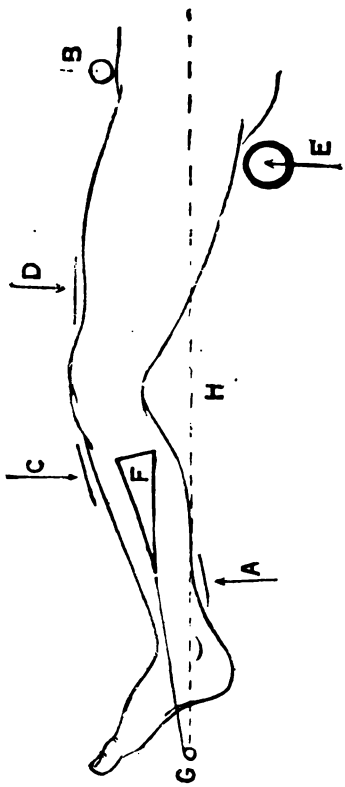

FIG. 115.—Showing points for application of pressure during reduction of deformity.

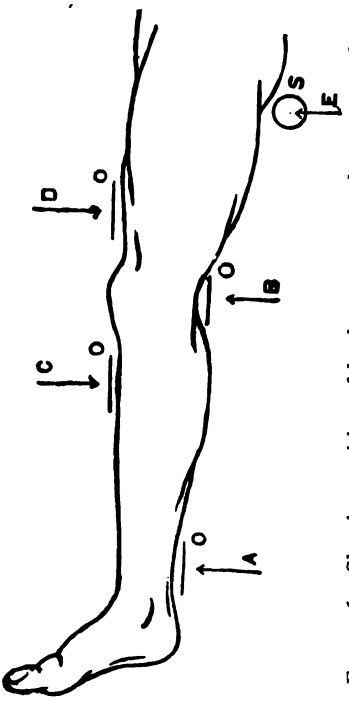

FIG. 116.—Showing position of leather supports and pressure pads.

The lower leather cross-strip is now placed at the back of the ankle, drawn snugly across, and sewed fast. The other leather strip is placed at the back of the knee or at the back of some part of the thigh if the knee is too greatly flexed to rest upon it, and it is drawn across to the opposite bar and sewed there. The knee is now pressed backward, straightening it as much as the patient will tolerate, and held there by a roller bandage, carried to and fro across the front of the limb, around first one side bar, and then the other; or a thick pad may be placed across the lower end of the thigh, well down upon the patella, and back-

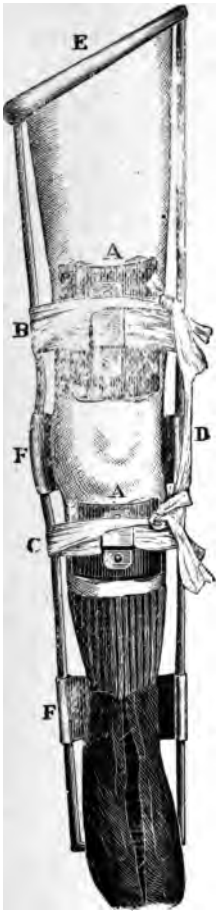

FIG. 117.—Calliper splint with pads applied.

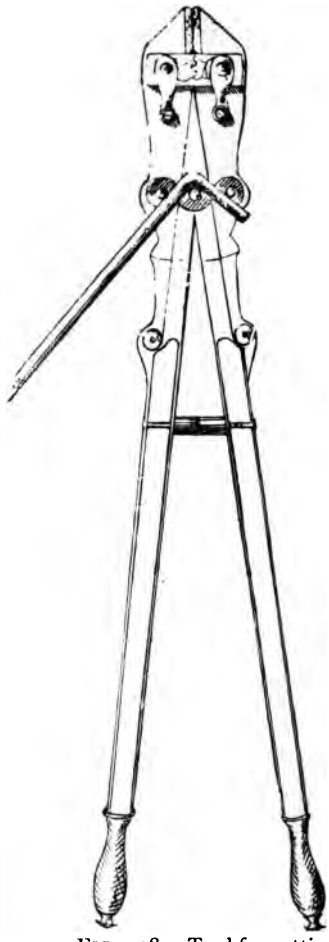

FIG. 118.—Tool for cutting splint and twisting it.

ward pressure made by a strong strip of bandage, passed across from side to side and somewhat downward, and tied to each side bar by a half-hitch, and then carried across the pad and tied (fig. 114). After this the traction tapes at the bottom are again tightened. The limb is left thus, if everything remains in place, for two or three days, when it can again be made straighter and the fastenings made tighter. In this way

the limb is straightened. If the limb is to be straightened
once under an anæsthetic, it is better then to apply immediatel
the calliper-splint, which will now be described.

The calliper-splint (fig. 117) is made from the bed-splint b
cutting off the lower end of the loop and bending an inch
more of each side bar inward at a right angle. The be
splint is at first applied and pushed well up on the straigh
ened limb, a point is marked on each side bar, half an inch belo
the sole, and an inch or an inch and a half below this; the sid

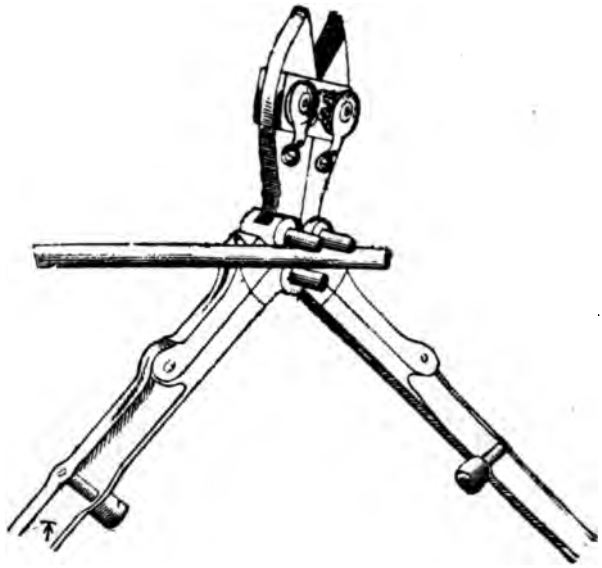

FIG. 118.—Showing how to bend lower end of cut bed-splint so as to introduce it into heel of boot.

bars are cut off at the second point, and the bend is made at th
first point marked. Fig. 118 shows the tool used for cutting o
these bars, and the process of bending them. The shoe is cu
at the heel, as shown in fig. 119. This mutilation of the shoe i
very necessary, or abrasion of the heel will take place durin
walking. A hole is next bored through the heel (fig. 120, lin
A B), or a slot made by a second hole (line C D), and a tub
inserted (figs. 121 and 122). Into the hole or tube the bent end
of the side bars are passed, the leather strips drawn fast an
sewed, and the limb tied or bandaged in place, as shown in fig

123, 124, 125, 126 and 129. If the knee is so swollen that the inner bar presses against it, this bar is curved with wrenches, or the tools (figs. 127 and 128) are employed. When a joint has been straightened under an anæsthetic, it should be left in the splint, without change of shoe, stocking, or bandages, until all pain and tenderness have passed off. In a word, the joint has been more or less sprained by the manœuvre, and must be treated with all the consideration which a sprain demands.

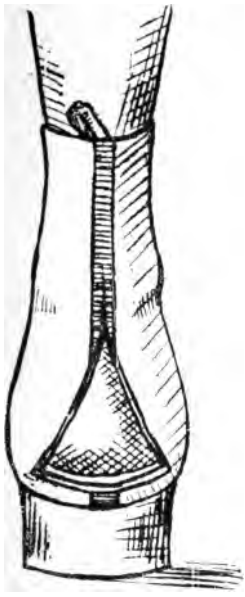

FIG. 119.—Shoe cut to prevent excoriation at heel.

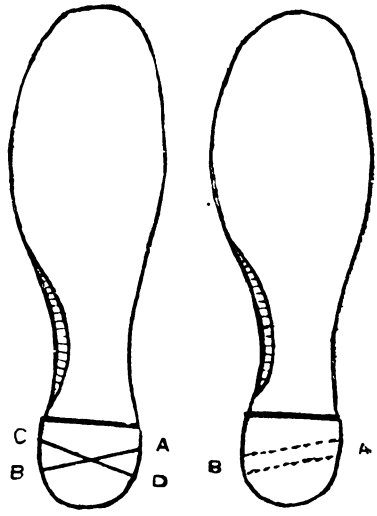

FIG. 120.

The deformity corrected, the patient should be kept off his feet until the muscular spasm which tends to deformity has subsided, when he may be allowed to walk about. If for any reason the patient has to be up before this time, he should use crutches or sticks and a thickened sole under the sound limb.

The backward luxation of tibia can be largely obviated by making the leather strip support the back of the tibia and by placing a little extra pressure on the lower end of the femur. Instead of bandage the authors generally use two shields made

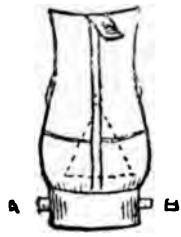

FIG. 121.

FIG. 122.

of sheet iron and covered with felt, as seen in figs. 124 and 125 This is much more effective and far simpler than the employ ment of bandages.

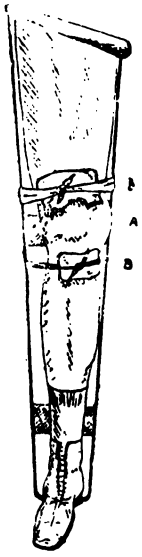

FIG. 123.

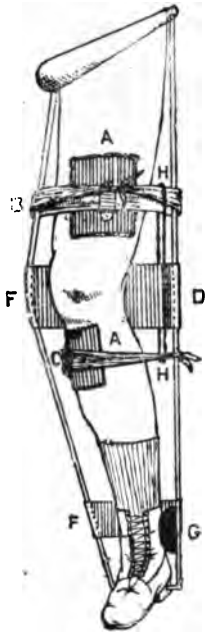

FIG. 124.—Showing application of pads where there is tendency to knock-knee.

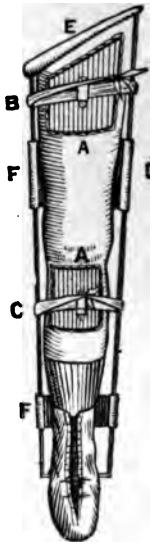

FIG. 125.

We employ this calliper-splint very extensively, and in th case of children particularly we would impress upon surgeon the necessity of making it sufficiently long so that the patient'

heel is a good inch from the boot. In this way the ankle escapes a jar which, were the splint shorter, would surely be conveyed to the knee.

The joint is more favorably situated than the hip for operative interference. Pulpy masses of tubercular tissue may be injected with the iodoform emulsion, tubercular abscesses may be aspirated or aspirated and injected, as may the joint cavity

FIG. 126.

itself, or any collection of fluid may be laid open, washed out and the wound closed without drainage. Any of these procedures, if aseptically performed, may hasten the date of recovery, but all are equally liable to be the cause of septic infection, and then do more harm than they could have done good had they been aseptically performed; and it may be emphasized that none are necessary unless the patient is already suffering from septic fever.

As to the major operations, erasion has no longer a place; it has no advantages over an excision in the final result; motion is never regained, relapses are the rule, and deaths from tubercular infection are frequent. Excision, as a time saving measure in

an adult case, may be employed if the patient chooses, but in our opinion is in no other way justifiable. Any joint that can be cured by excision can also be cured by mechanical means without excision, and with a better ultimate result. We, of course, refer to joints diseased, and not to the deformities remaining in joints no longer diseased.

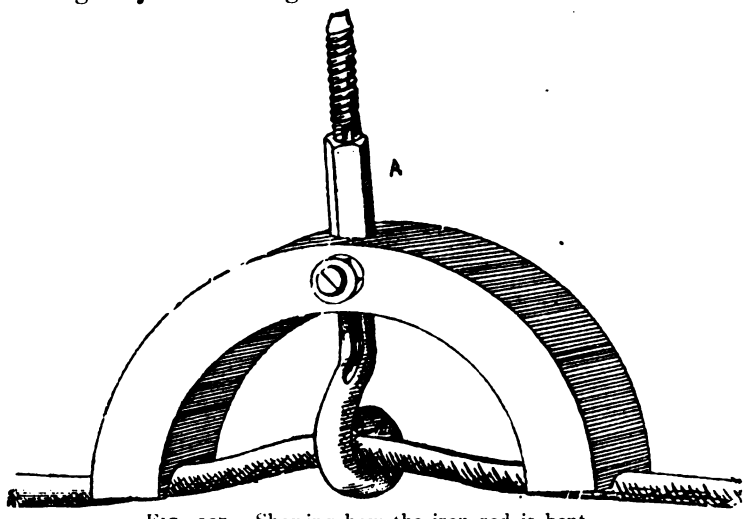

FIG. 127.—Showing how the iron rod is bent.

The result of an excision in an adult is a stiff, peg leg with from one to two inches shortening. This may be preferred by the patient to a somewhat longer course of treatment and a movable joint, or to an amputation and an artificial limb; but the evil result of the operation does not in children end with the healing of the wound; so long as the child continues to grow, the deformity of shortening increases, and when adult life has been attained the limb may be from three to nine inches short, and prove practically a useless member. In children, then, we consider that excision of the knee joint for disease is never justifiable. Any joint that cannot be cured without excision demands an amputation. For the correction of deformity in a cured joint several operative procedures may be employed; in false anchylosis, *brisement force*, followed by complete immobilization until the part has recovered from the injury done is often demanded. In true anchylosis, excision, osteoclasis, or

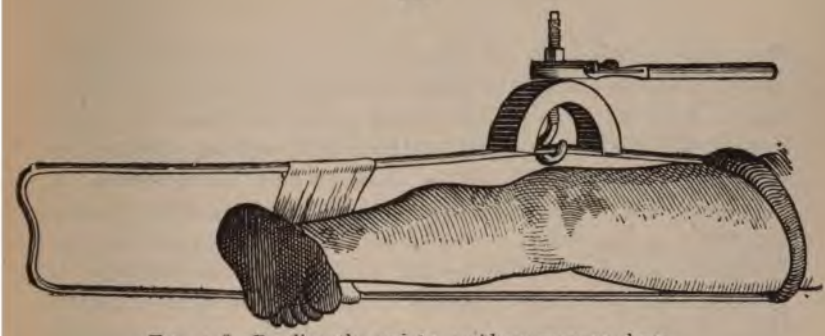

FIG. 128—Bending the rod to avoid pressure on knee.

osteotomy may be demanded according to the degree of deformity. Osteotomy by chisel is to be preferred if the subluxation be not too great, and if the irregular shape of the limb resulting

FIG. 129.—Showing disease at both knee and elbow.

from the operation be not objected to. In our opinion, osteoclasis although counted a safer operation, is not so in these cases. Excision of a wedge-shaped piece including the upper end of tibia, the lower end of the femur, and the patella with redundant soft parts, should be chosen where the deformity is very great, and where the neatest possible contour of the limb is an object in the result. The details of the operation are not demanded as they would be for an excision when disease is present, since the only direction necessary is to remove everything that is in the way of complete restoration to a straight line, and the only caution required is to remove enough to relieve all strain posteriorly, and all pressure between the sawed ends of the bones. Clean surgery and closure of the wound without drainage, and complete immobilization goes without saying.

The diagnosis of a cure at the knee joint is the same as at any other joint, namely: absence of pain, swelling, tenderness, and muscular spasm; no further restriction of motion in joints where there is motion, and no progressive tendency to deformity in joints where there is no motion.

ANKLE-JOINT AND TARSAL DISEASE.

THE ankle-joint, more than the knee, is subjected to sprains, and, as a consequence, traumatism plays an important part in its etiology. In other respects, disease at this joint arises from the same predisposing causes as elsewhere. The primary form of osteitic tuberculosis is comparatively rare; while the synovial tuberculosis is comparatively frequent. In the tarsus, primary synovial tuberculosis is rare, the disease almost always commencing in the bones. These facts must be borne in mind when considering the operative treatment of the disease, and for this reason we shall point out the difference in the symptoms; the mechanical treatment is the same in either case.

Symptoms.—Ankle-joint disease, when following a neglected sprain, presents a continuance of the symptoms due to the injury —namely, swelling about the malleoli and in front of the joint, more or less disability from restricted motion, and tenderness, and not infrequently there is pain. The foot becomes extended, walking is more difficult, the swelling increases, the lower end of the tibia and fibula become thickened, the bony outlines of the malleoli are lost in a pulpy swelling, and ultimately one or more tubercular abscesses form at one or both sides of the joint (fig. 130). Tubercular synovitis commences with a limp; soon there appears a pulpy swelling about one or both malleoli, the foot becomes extended and the normal motions are restricted, the swelling increases, and the part presents all the symptoms detailed above as developing upon a traumatic synovitis.

In the osteitic form of disease, the first symptom is the limp, pain comes on earlier and is more severe, the foot becomes extended, and all motions may be abolished before any swelling can be made out. Sooner or later the synovial membrane becomes involved, and the symptoms of a tubercular synovitis appear; or a small spot of pulpy swelling may appear at one or the other side of the foot without involving the joint capsule.

FIG. 130.—Showing tubercular disease at ankle.

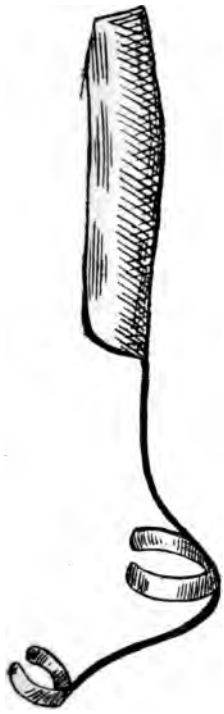

FIG. 131.—The Thomas "crab" splint.

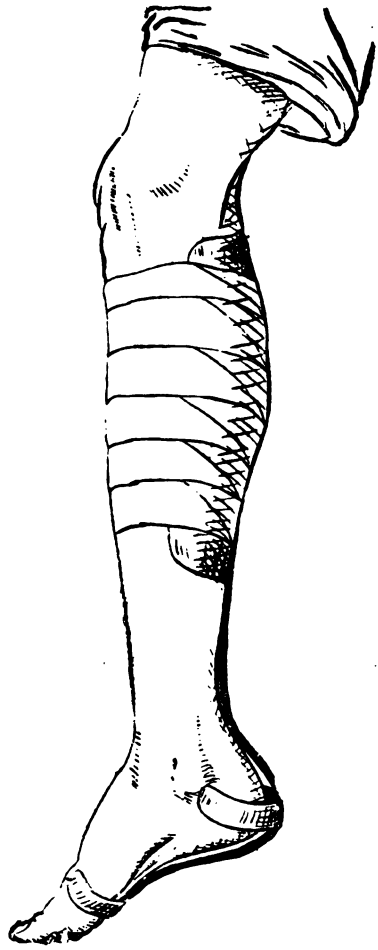

FIG. 132.—The "crab" splint *in situ*.

As already indicated, this pulpy swelling, if left untreated, almost invariably goes on to the formation of a tubercular abscess, which increases up to a certain size, and opens spontaneously. The usual tubercular discharge persists for a longer or shorter time, granules and flakes of bone come away, and finally the swelling subsides, the sinuses close, motion at the

articulation returns, and, with the exception of a few scars, the joint, in children, may be as good as ever. Permanent deformity and disability at the ankle joint are comparatively rare.

Tarsal disease arises, as a rule, in the same way, and presents the same symptoms as indicated under the osteitic form of disease at the ankle joint when the synovial membrane escapes. The differentiation between osteitis of the bones forming the ankle joint and those of the tarsus is found in the line of restricted motion. At the ankle joint, antero-posterior motion alone is restricted; lateral motion of the front part of the foot is free; in tarsal disease the lateral motion alone is restricted, antero-posterior motion being free to gentle manipulation. In severe and advanced cases both motions may be restricted, and it may be difficult to decide whether the rigidity is due to disease in both places, or to muscular shortening arising from the long continuance in one position.

Differential Diagnosis:—We rarely see hysterical affections of the ankle joint, and the points of differential diagnosis from traumatic, rheumatic, and septic affections are the same as in disease at the knee, and need not be repeated.

Treatment:—The principles of treatment are the same as elsewhere in the joints of the lower extremities, and the mechanical treatment of disease at the tarsus and in the ankle joint are the same. If the foot is extended, it should be returned as rapidly as possible to a right angle with the leg, since in this position it recovers most rapidly, and is most useful should any stiffness remain after the cure has been effected. Immobilization is maintained by the carb splint (fig. 131), which in our hands is more convenient and more effective than plaster-of-paris, though the plaster splint applied from the toes to the garter line serves a better purpose here than at any joint except the wrist. The crab splint consists of a piece of sheet iron hollowed to fit the posterior upper two-thirds of the leg. To this is riveted a bar of flat iron, five-eighths by three-sixteenths, or such size as will hold the part firmly, and it is bent to approximately follow the outline of the back of the ankle, and heel, and the middle of the sole of the foot. At the point where it passes around the bend of the heel is riveted a cross-piece of iron of the same width but only half its thickness, and long enough at each side to reach to the

FIG. 133.

tip of either malleolus; and at the end of the main bar is riveted a like piece long enough to nearly encircle the foot at the ball. The whole may be japanned and applied over a thin layer of cotton, or it may be covered with leather without padding, and applied next to the skin. The splint is bent to grasp the foot as accurately as possible, and held in place by a strip of adhesive plaster and a roller bandage (fig. 132).[1] Young children who can be kept off their feet, and adults who can be trusted with axillary crutches, require no further appliance, but in others the knee-splint extending from two to four inches below the foot with a patten bottom should be used. This is shown in fig. 133. The splint is made from the bed form of the knee-splint by cutting off the bottom of the long loop, and welding on at right angles an ovoid ring of flat bar iron three-eighths in diameter. The greater diameter of this ring should be from side to side, for if the greater diameter be from front to back the strain in walking is thereby increased, and it may break from the side bars. The knee-splint is supported by a webbing strap from the top ring passed over the shoulder of the opposite side. The limb is loosely held in this splint by a roller bandage at the knee.

The diagnosis of a cure consists in the absence of all symptoms, and increase of function by use. If anchylosis results, recovery is shown by the fact that the angle of deformity is a constant and not a changing one.

[1]The splint is made of wrought iron, and the calf support and wings should be sufficiently yielding to be easily moulded by the hands to the contour of the foot.

GREAT TOE DISEASE.

DISEASE at the metatarso-phalangeal joint of the first toe is not of very common occurence. It is usually seen in adults or adolescents, and more often than otherwise follows an injury. Cases are rarely seen before the disease is considerably advanced from neglect of treatment. The toe is more or less flexed (fig. 134), often extremely so, and held rigid by muscular spasm, the

FIG. 134.—Showing the flexion deformity in disease of the toe joint.

joint is somewhat swollen (fig. 135), tender to pressure, and often hot to the touch. Walking is difficult, or impossible, because of the flexion of the toe and the tenderness. The part demands immobilization, a metal sole plate held by adhesive plaster and a roller bandage. All tendency to motion can be avoided by building up the sole of the shoe posterior to the joint as indicated in fig. 136, or a block of wood an inch thick may be screwed to the sole of the shoe extending from the great toe joint to the posterior extremity of the heel. The flexion can usually be reduced within a fortnight; after that the immobilization and

FIG. 135.—Advanced case of disease of the great toe joint.

protection should be continued until a cure is effected. If the joint be tender to the touch, the leather opposite it should be removed, and a slack piece of kid inserted in its place (fig. 137). The results are comparatively rapid, and in all cases that have come under our observation, full normal function has been regained.

FIG. 136.

FIG. 137.—Boot blocked and slackened to render walking painless.

SHOULDER JOINT DISEASE.

CHRONIC disease at the shoulder joint is not of very frequent occurrence in either children or in those adults who, from the nature of their occupation, do not subject this joint to injury; but in certain classes of laboring men—*i. e.*, those whose work is of a laborious nature, injury of this joint is more frequent than that of any other, and enforced neglect from the necessity of unceasing labor very frequently results in chronic disease. In

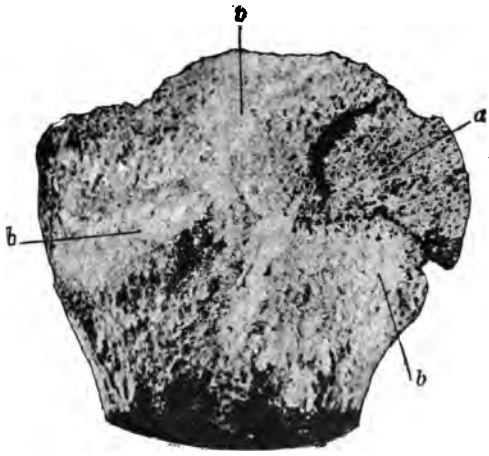

FIG. 138.—Head of humerus, sawed through in frontal plane; (*a*) wedge-shaped, completely separated, sequestrum, extending to denuded joint surface; (*bb*) extensive cheesy infiltration of the head; secondary infection from the sequestrum (Krause).

these adult cases which follow a wrench or neglected sprain the synovial membrane is usually affected, and the disease may continue as a pure synovitis, or the bone may become involved. In children and in the non-traumatic cases the osseous form of the disease appears first quite as frequently as in disease at the other joints. In osseous disease the trouble begins as a rule in the head of the humerus, rarely in the walls of the glenoid cavity (fig. 138).

The progress of the tubercular focus in the bone, or of the synovitis when it has become tubercular, follows very closely the

same course as in hip disease; the osseous focus becomes cheesy and ruptures into the joint cavity. Synovial disease progresses

FIG. 139.—Remains of the head of the left humerus in caries. Deep erosions. Contour of normal head indicated (Krause).

FIG. 140.—Upper end of humerus in dry caries Head entirely gone, covered by thin layer of firm tubercular granulations (Krause).

steadily, and by gradual encroachment the articular cartilage becomes eroded away, and the bone, owing to the caries, crumbles away (figs. 139 and 140). Liquefaction of tubercular materials may be sufficiently rapid to produce a tubercular abscess,

or a sequestrum, "caries necrotica", or so slow that no collection is felt and the "dry" form of disease is said to be present (fig. 141). In our experience, tubercular disease at the shoulder joint is more frequently dry than otherwise.

FIG. 141.—Dry caries of right humerus from front. Anchylosis during life. (*a*) Remains of head; (*c*) coracoid; (*d*) acromion; (*e*) body of scapula sawed off (Krause).

In the traumatic form which is associated with adult life and which has scarcely ever been referred to by writers, the chronic symptoms gradually become engrafted upon a slight synovitis; some have described a not dissimilar condition which they include in the class of osteo-arthritis. The condition however, presents many points of difference to tubercle, rheumatism, or to osteo-arthritis. The course is much more benign than tubercle; it occurs in subjects who are strong and active; it rarely, if ever, results in suppuration; it invariably yields to treatment and with but little variation in the length of time. From chronic rheu-

matism it may be readily recognized. It is not grafted upon an acute condition; it results from an injury; it is always worse after exercise; it is not an accompaniment of general rhuematism. With osteo-arthritis it should rarely be confounded. It never results in destruction or eburnation of joint surfaces; rest never tends to stiffen but to loosen the joint; it presents none of its characteristic symptoms; its clinical career has nothing in common with it. Rhuematism is certainly prone to complicate it, so

FIG. 142.—Cannot abduct arm without pain.

that the patient complains fitfully, often in accord with atmospheric conditions. This, however, is the case in other non-rheumatic conditions such as fractures, in injury of muscles, or even in a healing wound. The arm is held closely to the side; pain is complained of over the joint and often at the insertion of the deltoid (our friend Thelwall Thomas suggest this may be due to the constant endeavor of the muscle to hold the arm abducted); the patient is unable to sleep upon the shoulder and should he

accidently lie upon it he awakens in pain; acute pain is experienced upon pressing a point just below and to the outside of the coracoid process which corresponds to the front of the humerus. There is an inability to rotate the joint either inwards or outwards without discomfort. Abduction is limited and elevation of the arm impossible. The surgeon, in short, elicits from the patient the following story: "My arm is weak and painful; I dare not lie upon it at night, or the pain becomes incessant; I cannot lift it from my side (fig. 142) beyond a short distance; it pains dreadfully if I attempt either to get my hand behind my back

FIG. 143.—Painful in trying to put arm behind back.

(fig. 143) or behind my head (fig. 144), and yet I can touch my opposite shoulder with no discomfort (fig. 145) and I can with equal ease push my arm forwards (fig. 146)." So correct is this clinical description that the authors are never at a loss to anticipate a patient's story.

Subsequently shrinking of the shoulder muscles takes place, and finally the limb may become wholly useless. If abscess forms, which certainly rarely ever occurs in this adult variety, the first true fluctuation will be made out in front of the joint.

In tubercle, where the trouble is primarily in the bone the first symptom is usually restriction to full rotation and to carrying the arm backward. The patient finds that he cannot when dressing reach behind him and adjust his clothing with the accustomed freedom and dexterity, and the arm is held hugged to the side. Next, he experiences discomfort when lying upon this side, or on awakening from having slept upon his shoulder he experiences severe pain. Shrinking of the muscles comes on early and is a constant symptom. The progress of the disease, unless aided by art is from bad to worse. The complications are abscess and subluxation. The tendency of the tubercular abscess is the same as elsewhere; if untreated, it descends as it approaches the surface and ultimately ruptures; if treated, a large percentage gradually disappear without going on to spontaneous rupture. Chronic abscess in the shoulder joint escapes through the least protected parts of the capsule, and is subsequently directed in its

FIG. 144.—Painful when trying to place arm behind head.

course by structures which form a large shield over the joint. The joint is supported and protected by two successive muscular coats, the first or deeper being intimately associated with the fibres of the capsule, the superficial protection being the deltoid muscle. The muscles touching the capsule consist of the Subscapularis, Long head of Triceps, Supra Spinatus, Infra Spinatus and Teres Minor, the last three being intimately blended into a continuous mass. In this coat weak spots exist in two places, above and below the Subscapularis. In the part above the capsule is supplemented within by the long tendon of the biceps which courses in the interval and escapes through a hole in the capsule, in the part below the capsule is thinnest and least protected. Pus having escaped through one of these undefended spaces finds itself either under the deltoid, and is forced to point near the front or back of its insertion, or in the axilla.

FIG. 145.—Can easily push arm forward.

No attention has been drawn by previous writers to the pathological displacement which occurs in a large number of tubercular shoulders (figs. 147 and 148). It is not necessarily dependent upon liquefaction of the head of the humerus. It is almost always accompanied by anchylosis. This condition is not dissimilar in appearance to an old unreduced traumatic dislocation. The head of the bone is not in reality very much out of position, but the capsule of the joint has become shortened, and this, in conjunction with the hugging of the arm and the marked atrophy of the deltoid, produces a strong likeness to a subclavicular or to a sub-coracoid luxation (fig. 149).

One of the authors has, on frequent occasions, been asked to reduce such shoulders, the patients and often their medical advisers failing to recognize the true nature of the lesions. We will briefly relate the history of a case by way of example, which

FIG. 146. —Can readily touch opposite shoulder.

FIG. 147.—The halter applied showing how subcoracoid luxation begins to show itself

shows the danger of not making a correct diagnosis. A gentleman brought his son, a youth of nineteen years, to one of the authors to consult about his shoulder which, it was said, had been dislocated for over two years. He had already been to the metropolis and had consulted three surgeons of repute. One had suggested excision of head of the humerus, another manipulation under anæsthetics and the third counselled a let-alone policy. All of them, however, acquiesced in the belief that they were dealing with a case of neglected dislocation. When the patient was examined we had no difficulty, even before enquiry into the history of the lesion, in deciding that the case was one of pathological subluxation following arthritis. The patient's father

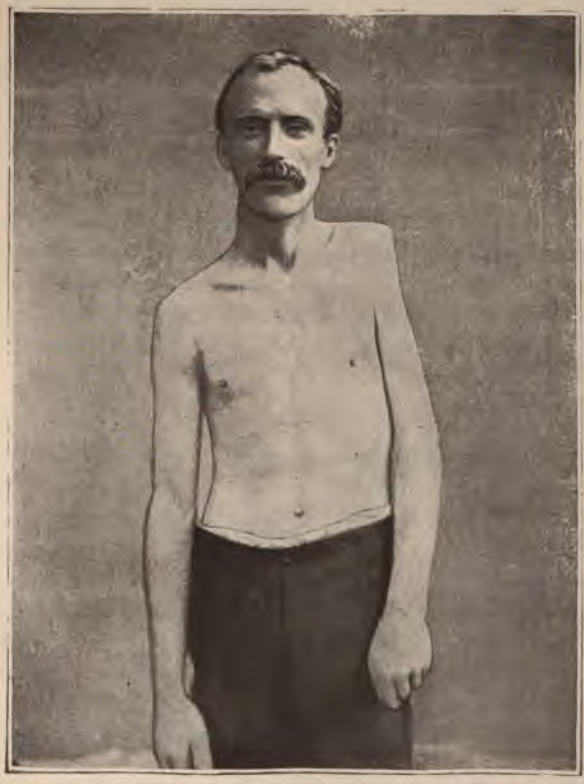

FIG. 148.—Arthritis with anchylosis. Pathological displacement of head of humerus.

became convinced of the correctness of this later view when we were able without being prompted to tell him the main outline of the course the diseased shoulder had gone through. The facts were briefly these. The boy fell from the box of a brougham upon his shoulder; it was painful and swollen. The family doctor called next day, prescribed rest and evaporating lotions and after a week's attendance left his patient with a few general instructions. In a fortnight after the accident he was able to use his shoulder but with some discomfort. He always complained of pain on lying upon the joint. Examined two months later by an experienced surgeon a dislocation was pronounced, to the discredit and humiliation of the local practitioner who fully believed he had made a serious initial error. In this case, as in others, the differential diagnosis from the old traumatic displacement was not difficult. Anchylosis was complete, which is rarely the fact in neglected luxation.

The muscular shrinking was more marked, the head of the bone less really displaced, and the coracoid more prominent than would have been the case in an old dislocation. How important, therefore, it is, both for the sake of the patient and the previous attendant, that the differences and similarities between the two conditions should be noted; for it must be emphasised that tubercular arthritis of the shoulder without suppuration often results in anchylosis, such anchylosis being an accompaniment of the pathological displacement.

Differential Diagnosis.—The diagnosis in the traumatic cases is materially aided by the history of the injury and, although rheumatism may attack an injured joint, too much credit must not be given to the rheumatic theory. Tubercular osteitis should not be mistaken for rheumatism becuase of the insidious onset and absence of early involvement of the soft parts.

When shrinking of the muscles is extensive and in cases that have experienced no pain, the part in appearance resembles certain spinal and traumatic palseys. In paralysis, however, there is abnormal passive mobility, while in joint disease the mobility is diminished or altogether wanting.

Prognosis.—Without treatment the disease almost invariably results in a shrunken, shortened, stiff and somewhat useless mem-

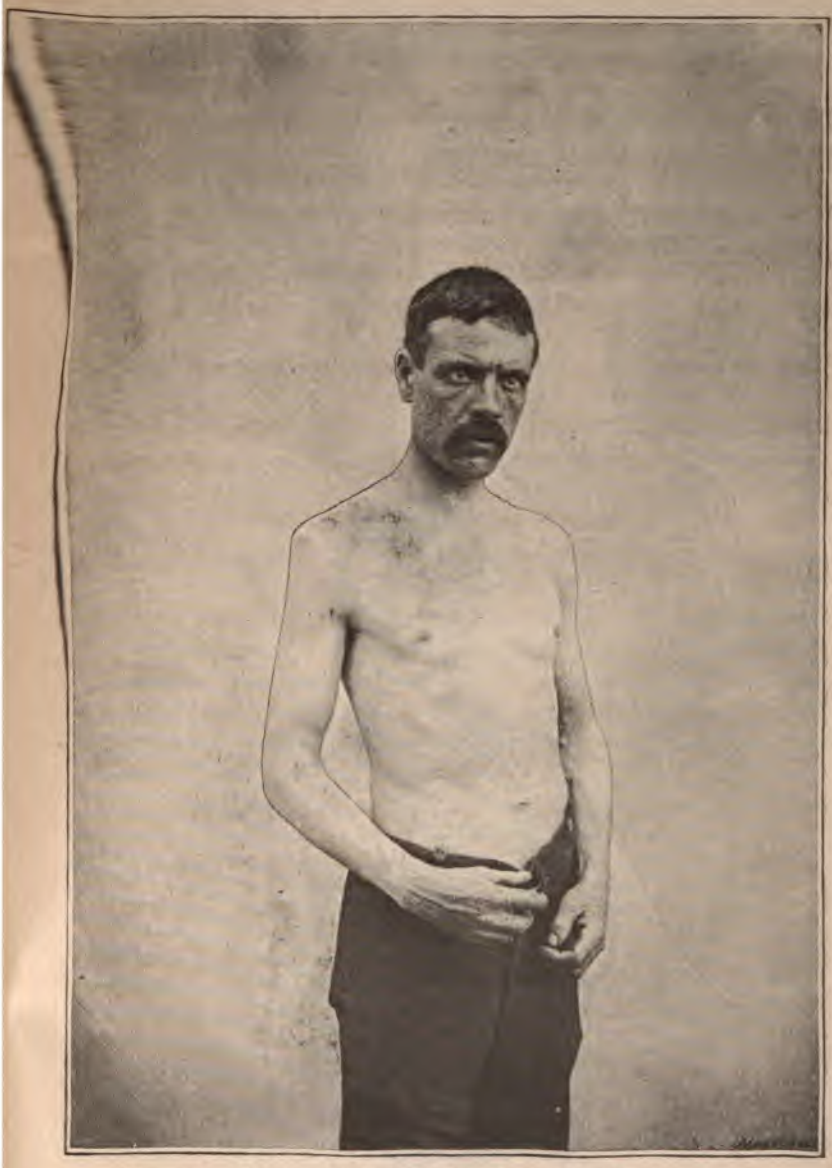

FIG. 149.—Showing subclavicular luxation in shoulder joint disease accompanied by anchylosis.

ber. Under treatment, the shrinking, shortening and stiffness are lessened, and if commenced sufficiently early and faithfully carried out, a perfect cure not infrequently results with full restoration of normal function.

Treatment.—The mechanical treatment of shoulder joint disease is not by any means theoretically perfect, on account of continued movement of the thorax and shoulder girdle during respiration, though practically the results are good. Immobilization by leverage is not easily made; neither can the joint be satisfactorily held by any of the plastic dressings which surround the arm and the chest. Traction can be applied more readily than at any other joint, but its use aggravates the pain in most cases, and the treatment gives less good results than at joints where it can be less advantageously applied.

FIG. 150.

The treatment which we have found most useful consists in restraining voluntary movements by applying the "halter" about the wrist and neck (fig. 147) and at times a supplementary band from the elbow round the body. A restraining influence is brought to bear locally by covering the shoulder with numerous strips of pitch plaster spread on stiff paper. These strips are laid on one over the other covering the shoulder and extending well down over the scapula on the back, and over an equal distance in front (fig. 150).

In a few cases the weight of the arm gives rise to a dragging pain, and it is of advantage to support the member by a broad bandage passing from under the elbow over the shoulder of the opposite side.

In shoulder joint disease tubercular abscesses can more readily than elsewhere be aspirated and their cavities and fungoid masses injected with the iodoform mixture and often with good result.

The treatment of the adult variety of chronic shoulder is the same as if it were tubercular; rest from pressure, friction and function. Treatment usually lasts from three to five months and the test of recovery most convenient to the practitioner is the patient's ability to sleep painlessly upon his joint. This form never results in anchylosis unless neglected. The test of recovery in tubercular cases is in a fixed and painless anchylosis, or where anchylosis does not exist, a range of motion which may tend to increase but never to diminish. With scapular movement always available, excision of the shoulder is never called for.

ELBOW-JOINT DISEASE.

Chronic disease at the elbow-joint arises from neglected injury and from constitutional discrasia in the same way as does chronic disease at the other articulations. The joint is fairly frequently subject to injuries so slight that they are neglected and allowed to become chronic; but here, more frequently than elsewhere, do we find chronic disease following severe injuries. As a rule joints suffering from dislocation or fracture after reduction are immobilized until a cure has been effected; but the elbow forms an exception to this rule. The joint is so favorably situated for "surgical manipulations" and "passive motions" that few surgeons have been able to restrain themselves from these most harmful pastimes, and as a result one is asked to treat a tuburcular elbow that would never have been tuburcular had it escaped such treatment for the original injury. We would not say that a dislocation at the elbow or a fracture into the joint should not be treated, but we believe that it would be better to leave such untreated than to commence forcible bendings before a complete subsidence of the inflammatory process. Tuberculosis may here, as elsewhere, commence as a primary or secondary focus in the bone or in the sinovial membrane; and as a synovitis it commences here next in frequency to the same condition at the knee. Chronic disease, the result of inherited syphilis, is not infrequently met with at this joint.

Disease following a neglected slight traumatism has its symtoms grafted on to those of the original injury. When first seen there is some obliteration of the normal bony outlines; thickening and some tenderness can be made out between the olecranon and the condyles on either side, and there is some restriction to full flexion and extension, but no true involuntary muscular spasm.

As the case progresses the swelling increases, the thickening becomes more pulpy and ultimately fluctuates, and sooner or

later the bone is invaded, and then true muscular spasm restricts the joint motion.

A tuburcular synovitis presents no symptoms except swelling and a slight elastic restriction to full flexion and extension, until the bone is invaded or an abscess forms.

Those cases which follow severe injuries and result from the efforts of the surgeon in the direction of passive motion follow much the same course. The thickening, the tenderness, and the restricted motion are still present when the passive motion is commenced, and they go on increasing until all the structures are involved and muscular spasm absolutely locks the joint.

The symptoms of a tuburcular osteitis are restriction to normal motion, a sense of weakness often accompanied by an aching pain, and shrinking of the muscles both above and below the joint. When the tuburcular focus has made its way out of the bone, whether into the joint or external to it, swelling appears, at first pulpy to the touch, and afterwards breaking down into tuburcular abscess, which presents, in the majority of cases, below and to the outer side of the external condyle. The forearm becomes flexed from forty to seventy degrees, and motion is almost, or quite, lost: the bone ends become thickened, and numerous sinuses appear, or in the dry form of disease little or no swelling and no abscess may be present.

The prognosis of elbow-joint disease without treatment is not often determined, for the surgeon is greatly prone to excise this joint. The results of excision are perhaps better here than at any other joint, but so also are the results of mechanical treatment without operative intererfence. The ultimate result as to motion depends of course upon the extent of the disease; nevertheless, a few joints recover anchylosed, but the vast majority regain normal motion when treated by efficient immobilization. The treatment consists in placing the member as soon as possible in such position as will prove most serviceable in case partial or complete anchylosis should result, and retaining it uninterruptedly in that position until a cure has been effected. The position of election is that of complete flexion; such a position as will enable the person to feed himself and dress his hair, should anchylosis result. If the forearm can be bent that far at once without considerable suffering, this is done; if not, it is carried

as far as possible towards the neck, and the head is bent as far forward as possible to meet it, and the halter snugly applied. By the end of two or three days the head will have become erect and the forearm will have by that time much approached the desired angle; the head is again bent forward and the slack in the halter taken up. This is repeated until the desired position has been gained. The halter is then left at that length until the joint is cured. One of the authors is in the habit of fixing the wrist to the neck in full flexion the moment the elbow is found to be affected. If this be done complete rest is secured for the joint, as the halter prevents extension and the neck prevents

FIG. 151.—Showing the "halter" in position.

flexion (fig. 151). If anchylosis threatens, there will be ample time to drop the wrist to a useful angle and by this time the graver symptoms will have abated. The useful angle in the case of a laboring man is about 90°; in the case of a shop assistant, about 100°; while many folks with ample means prefer an anch-

ylosis of about 35°, which enables them to be less awkward at table and at meals.

The halter consists of a piece of broad bandage sufficiently long to go around the wrist twice or thrice, and thence around the neck. It may be fastened around the wrist with a "half hitch," or passed twice around and knotted. It must be loose enough not to constrict, and yet so tight that the hand cannot be drawn out of it. Near the neck the bandage is again knotted, and then tied around the neck. Sometimes the halter is left around the neck without interference for some months. In such cases, if the surgeon can manage it, the bandage should be passed through a tube of leather which acts as an excellent padding against the neck and then through a leather band stitched around the wrist (fig. 151).

All knots should be sealed to render it certain that the dressing has not been tampered with. The dressing should be changed only when cleanliness demands it. Splints in the case of the elbow should be avoided; they interfere, by pressure on the vessels of the arm, check reparative processes, and materially add to the patient's discomfort.

Operative procedures consist in aspiration of abcesses, and injection with the usual iodoform mixture, and for this the elbow joint is favorably placed; there is, however, no evidence that the ultimate cure is hastened by any such operative means. On the contrary, the spontaneous abscess evacuation of which we have so often favorably spoken, (see articles on the hip and spine), should be the surgeon's aim in the management of this joint.

Excision is more favored by general surgeons here than elsewhere because of the better results obtained; nevertheless, we believe that any joint that can be cured by an excision, gets well without that operation, and results in a far more useful arm. The most imperfect results obtained by mechanical treatment give a stronger arm than the best results from excision. Only as a life-saving measure should excision be considered, and in such a circumstance the choice must lie between it and an amputation.

The test of recovery in this joint can be easily applied. It is founded on the principle that as disease advances motion becomes limited. When the swelling has subsided and the patient feels

his arm well, the experiment of testing may be undertaken. The "halter" is lengthened two inches, and the wrist allowed to drop. If, in a few days the patient is able to lift his hand to the point from which it was released, recovery is assured, and the wrist may be allowed a further drop yet. If anchylosis has resulted, the test of its soundness may be made in accordance with the principle that a stiff joint is free from disease when it does not change its angle by use.

WRIST-JOINT DISEASE.

CHRONIC disease at the wrist-joint is of rare occurrence in children, except among the children of syphilitics. In adults, it more frequently than otherwise appears to follow sprains and other slight but neglected injuries. In such cases it commences as a synovitis, and the prominent symptom is the swelling of the part. Cases are met with, however, where there is no swelling, and where the restricted motion and muscular spasm point to an osteitic focus. In these cases, as in the tarsus, swelling as a rule comes on early and the part presents heat, pain, restricted motion,

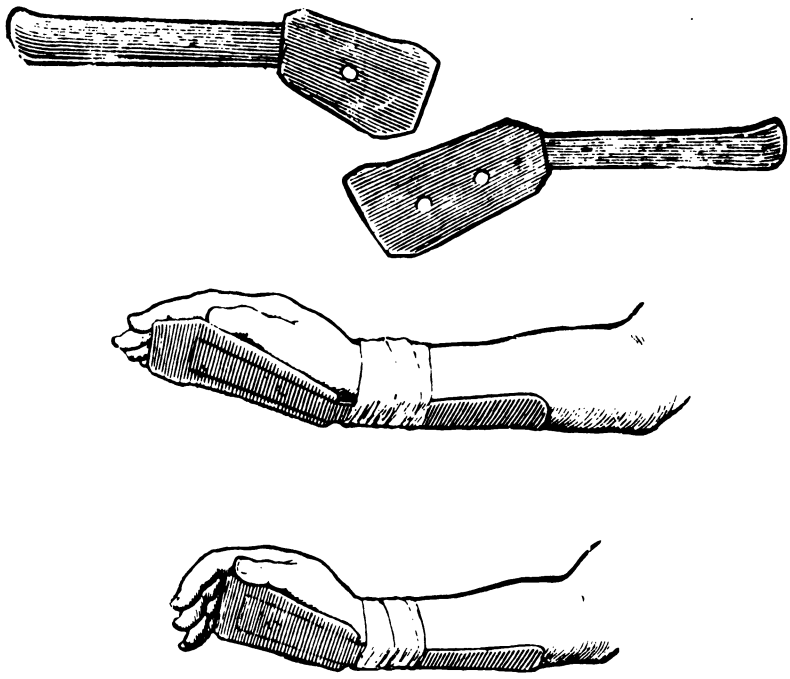

FIG. 152.—Showing hand kept at angle to forearm in order to intensify the "grip" should anchylosis occur.

and some deformity in the direction of flexion, the patient generally presenting himself supporting the diseased part with the other hand. Left untreated, the hand may become flexed to a right angle to the forearm, and all motion is completely lost (fig. 153). Abscesses form, as a rule, and are generally met with on the dorsum of the wrist and hand.

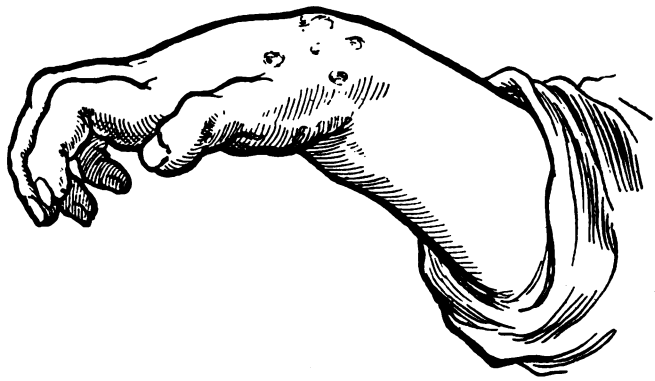

FIG. 153.—Showing anchylosis in faulty position.

The prognosis from mechanical treatment is good, both as to position and usefulness. The treatment can be most satisfactorily conducted by a simple splint of sheet iron, bent to a hollow to fit the forearm, and with a T-shaped ending at the hand, the part of the splint upon which the hand rests should be placed at an angle of about 40°, the lateral wings of which are bent around and grasp the hand at the metacarpo-phalangeal articulation—the whole being held in place by strips of adhesive plaster. The flexion should be overcome as rapidly as possible, and the hand immobilized in an extended position. This extended position is of great importance in the treatment of the wrist, and is not referred to by any writers on the subject. If any one wishes to grip powerfully, the wrist is first instinctively extended. One cannot effectively grip with the hand in the flexed position. The lesson to surgeons is obvious. In arthritis of the wrist place the hand upon a splint which keeps the hand extended (fig. 152) upon the forearm; by this measure every available advantage will accrue to the subsequent action of the extensors of the wrist. So true is this that when a patient consults us, complaning of

faulty fingers, should his wrist be anchylosed at flexure, we promise improved power of flexion at the fingers when the anchylosis is attacked by the wrench (fig. 154) and the wrist placed in extension instead of flexion. The forearm is then suspended to a comfortable position in a sling or halter. The management of abscesses is the same as at other joints. Excisions and erasions are no more demanded here than elsewhere, and, as at the tarsus, are more mutilating in their results than at the larger joints. As a life-saving measure they may be demanded, as may amputation.

FIG. 154.—Attacking faulty anchylosis with the wrench.

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